CDF Search for Resonance Production of Top anti-Top Pairs

$$\boxed{p\bar{p} \rightarrow X^o \rightarrow t\bar{t}}$$

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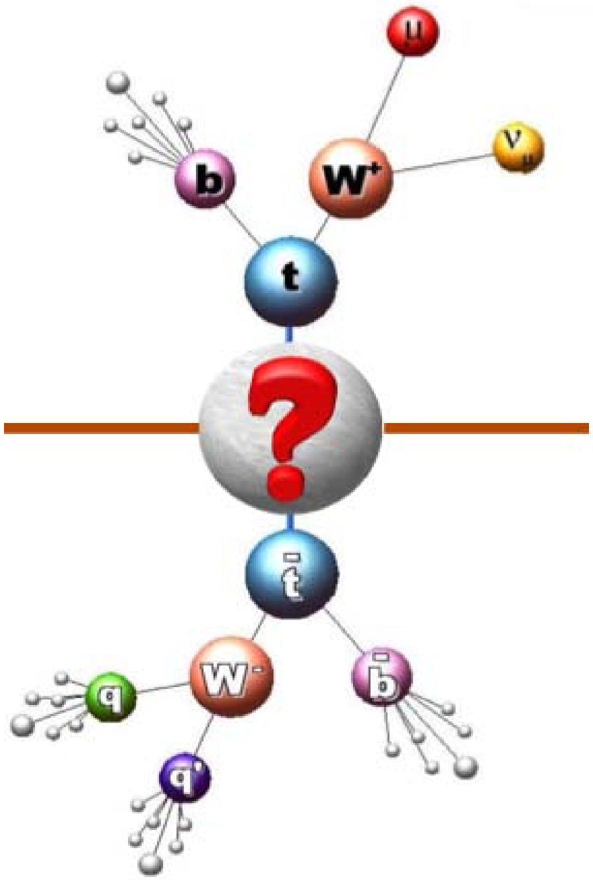
University of Florida



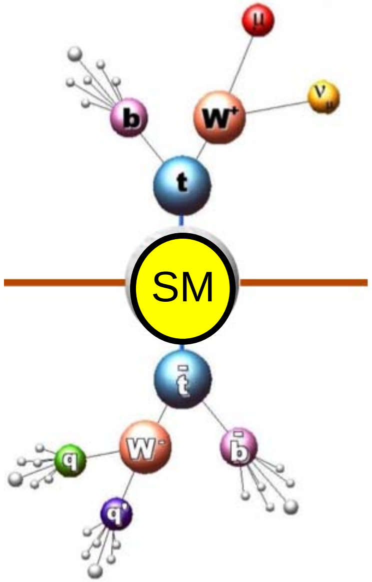
Introduction

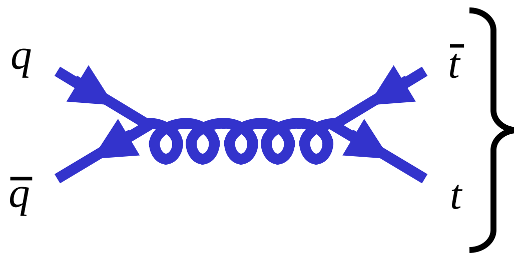
- Top is the youngest among the quark family
  - Top Turned Ten...
- High mass near EWSB scale
  - *Gives insight about Higgs*
- Tevatron provides a unique opportunity to learn a lot about this "exotic" particle now
- Studying tt production in detail is particularly interesting
  - Of course, tt production tests QCD
  - New physics can make an appearance here
    - Cross section measurements are sensitive to new physics
    - Important to also test directly the mechanism of tt production
      - Hopefully top will misbehave in its teenage years !

Goal here:

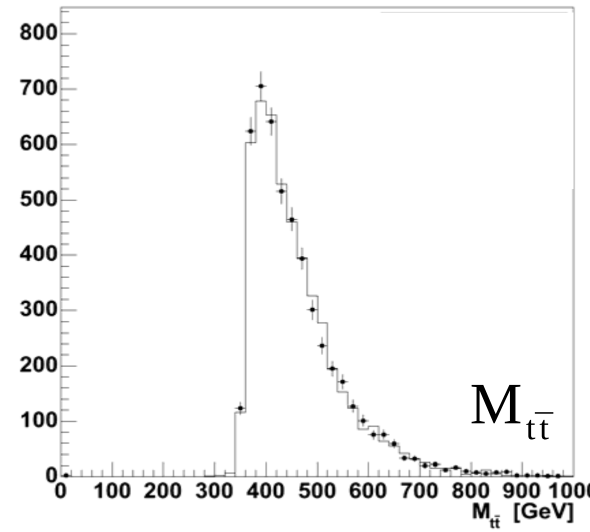
Test ttbar production for possible new sources such as a narrow resonance

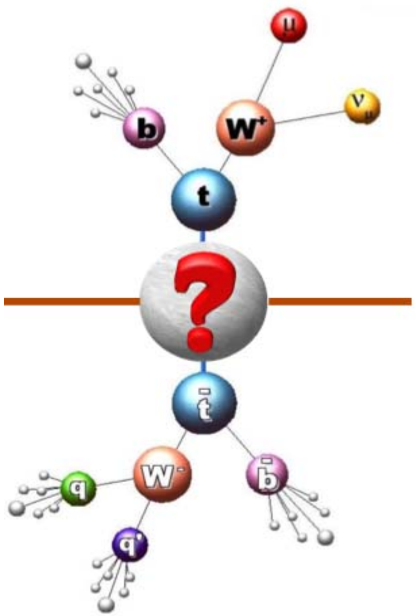
Looking for resonance production

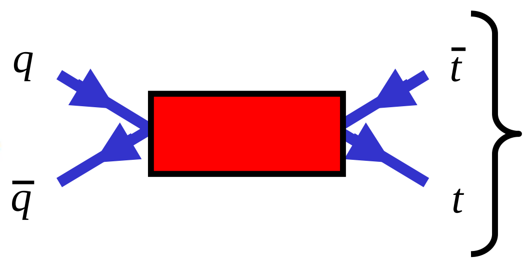




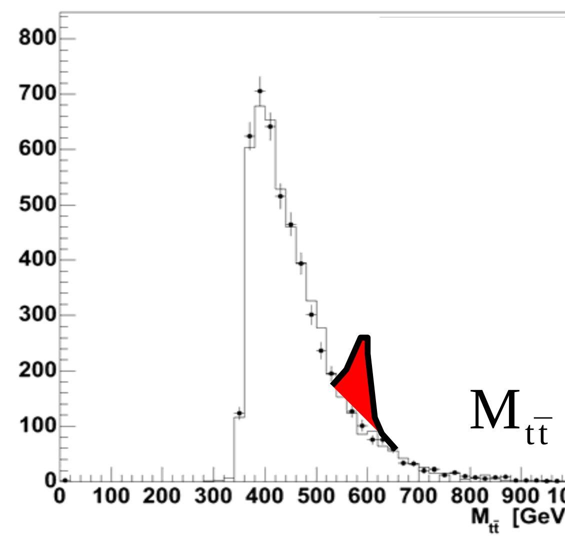
SM invariant
tt mass





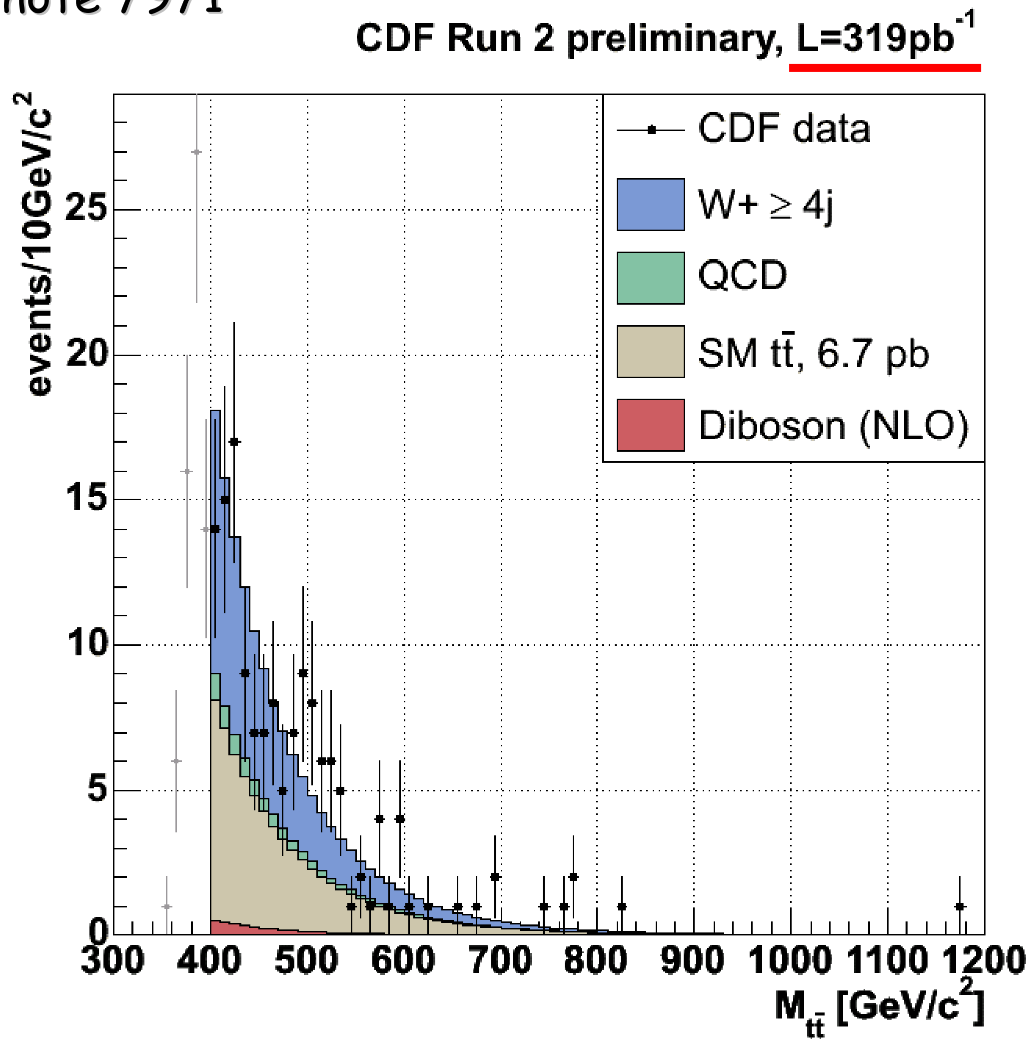


Invariant
tt mass with
X



Excitement in the air

- **CDF results from last September**
  - o cdf public note 7971



Outline for this talk

WHY —

HOW

WOW ? —

- Motivation for resonances
- Quick Top & CDF reminders
- Analysis methodology
- Results from 680 pb^{-1}

Some theoretical motivation

PHYSICAL REVIEW D VOLUME 49, NUMBER 9 1 MAY 1994

Top quark production: Sensitivity to new physics

Christopher T. Hill* and Stephen J. Parke†
Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois, 60510

(Received 23 December 1993)

The production cross section and distributions of the top quark are sensitive to new physics; e.g., the $t\bar{t}$ system can be a probe of new resonances or gauge bosons that are strongly coupled to the top quark, in analogy with Drell-Yan production. The existence of such new physics is expected in dynamical electroweak symmetry-breaking schemes, and associated with the large mass of the top quark. The total top quark production cross section can be more than doubled, and distributions significantly distorted with a chosen scale of new physics of ~ 1 TeV in the vector color singlet or octet s channel. New resonance physics is most readily discernible in the high-p_T distributions of the single top quark and of the W boson, and the mass distribution of the $t\bar{t}$ pair.

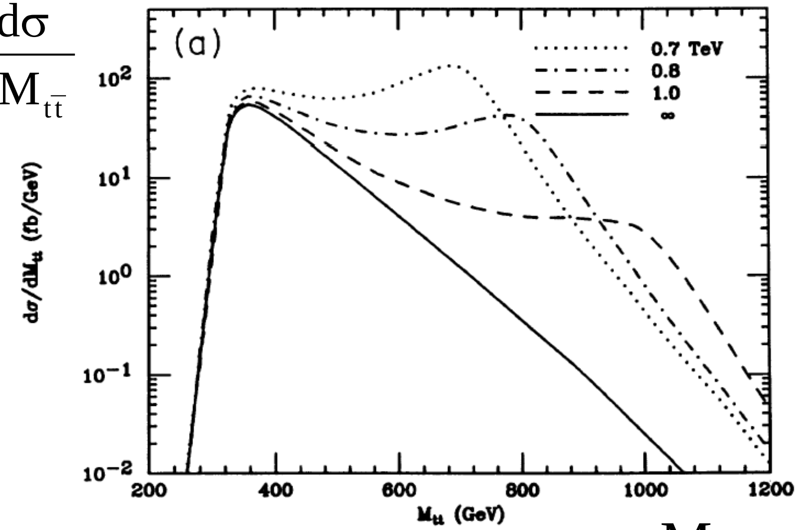
PACS number(s): 14.65.Ha, 12.60.−i, 13.85.Ni

Strong Dynamics (circa 1994)

Top-Z’ or color singlet
vector t-meson/gauge field

$$g_3(\bar{z}_1\bar{\psi}\gamma_\mu\psi+\bar{z}_2\bar{t}\gamma_\mu t)B^\mu$$

$\dfrac{d\sigma}{dM_{t\bar{t}}}$

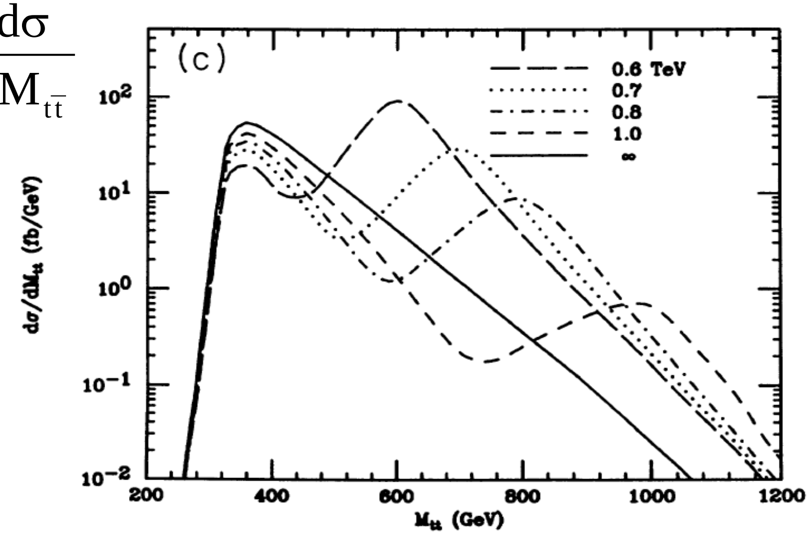


$M_{t\bar{t}}$

Topgluon or color octet
vector t-meson/gauge field

$$g_3\left[z_1\bar{\psi}\gamma_\mu\frac{\lambda^A}{2}\psi+z_2\bar{t}\gamma_\mu\frac{\lambda^A}{2}t\right]B^{A,\mu}$$

$\dfrac{d\sigma}{dM_{t\bar{t}}}$



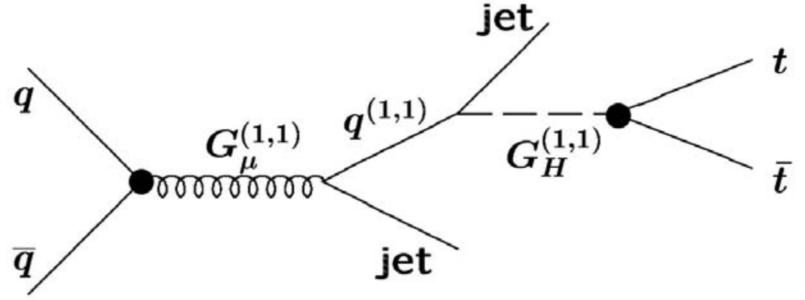
$M_{t\bar{t}}$

Universal Extra-dimensions (circa last friday)

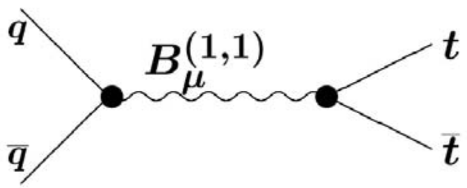
Standard model in 5+1 dimensions *(Burdman, Dobrescu, Ponton, hep-ph/0601186)*

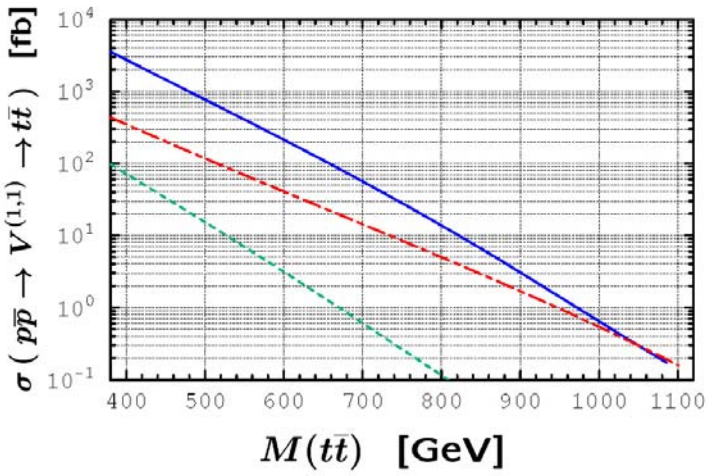
Kaluza-Klein mode of the gluon has cascade decays to gluons polarized along the extra dimensions $G_H^{(1,1)}$.

$G_H^{(1,1)}$ (spin-0, color octet) couples to quarks proportional to their mass.



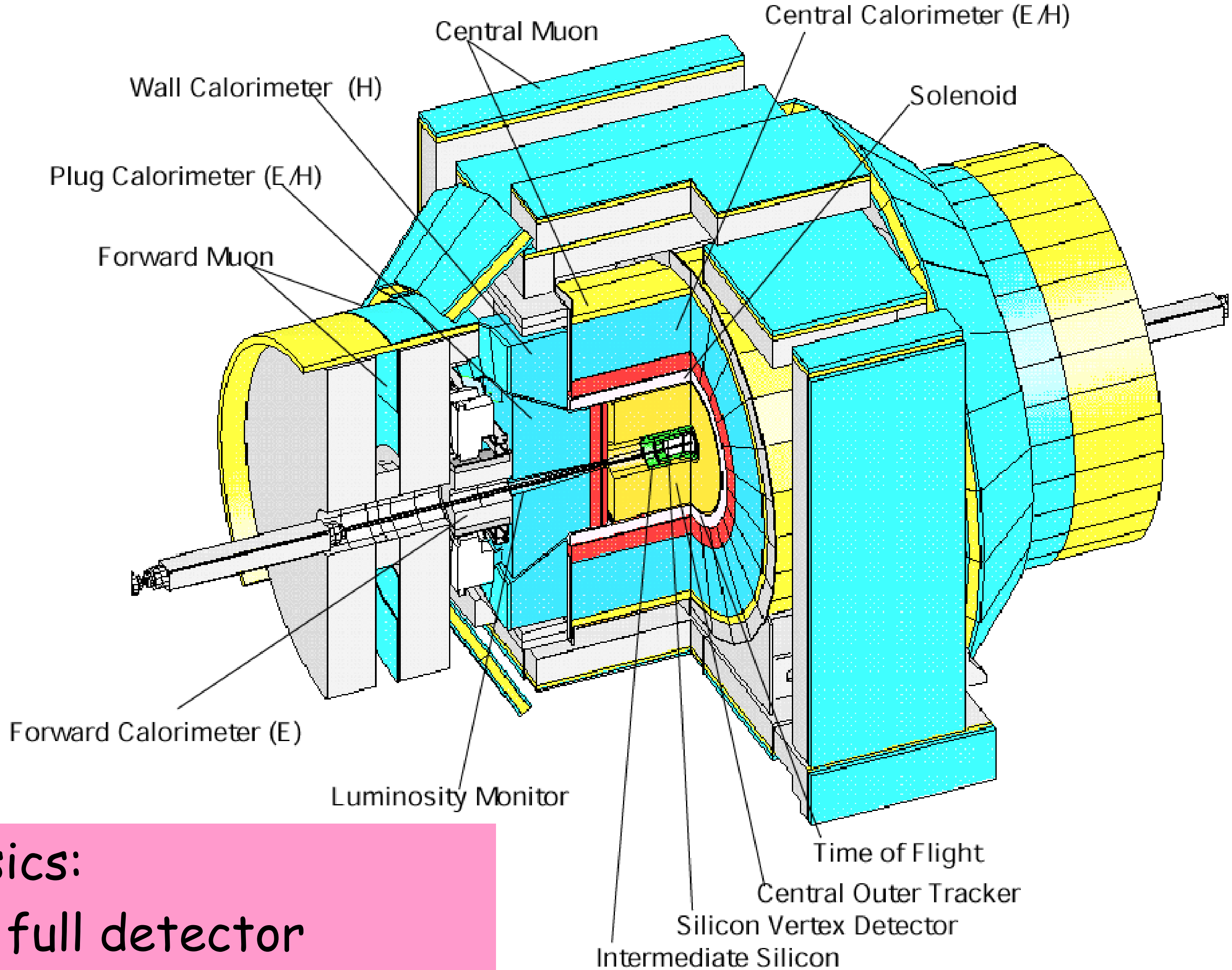
Kaluza-Klein mode of the photon, $B_\mu^{(1,1)}$, has Br$(t\bar{t}) \approx 25\%$





Ultimately we are also guided by our own curiosity as experimentalists

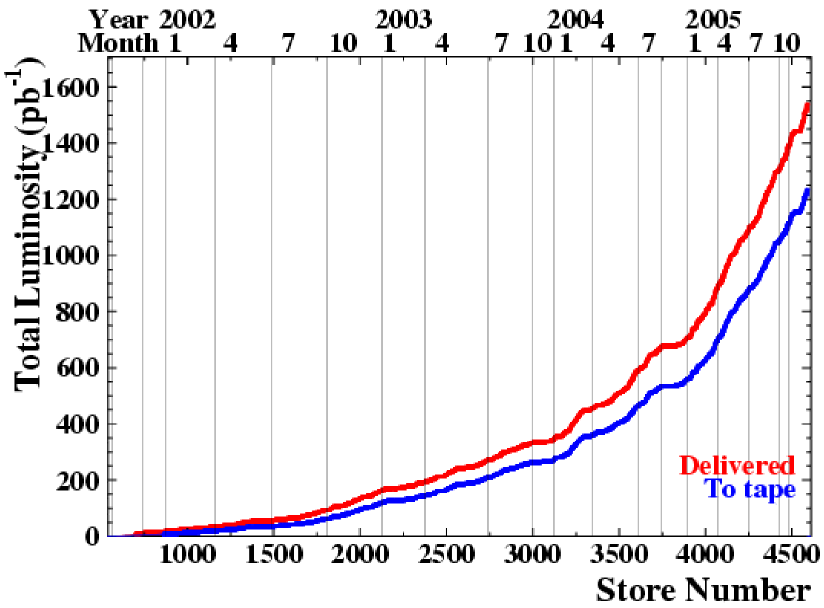
Where?



For top physics:

- Need the full detector
- As large a dataset as possible

Where?



Data presented here:

319 pb^{-1} until august 2004

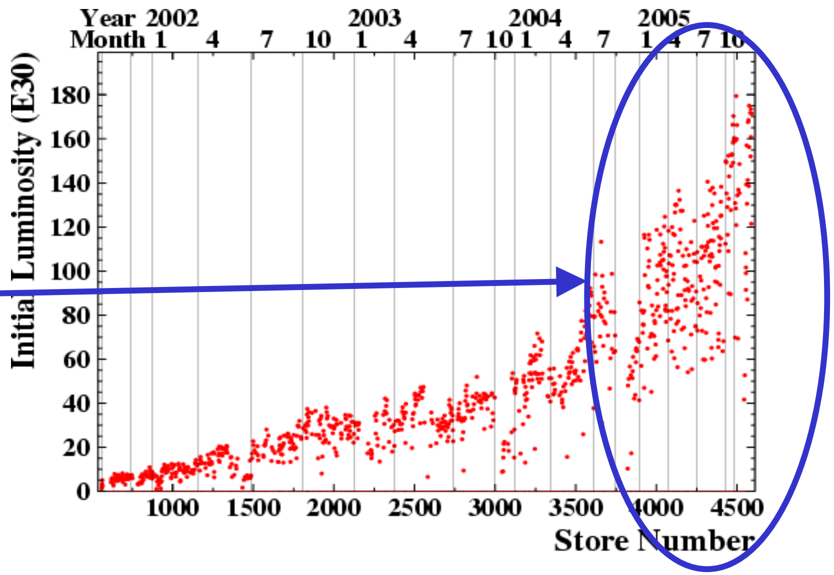
public results september 2005

682 pb^{-1} until september 2005

public results 4 months later!

~ 1 fb^{-1} by Summer 2006

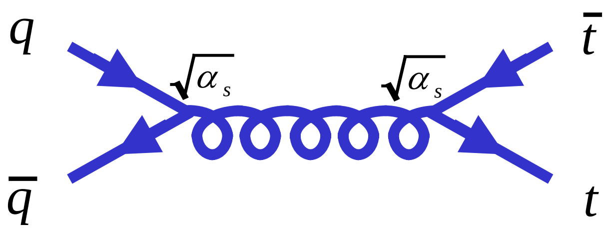
- We are getting faster
  calib, processing, analysis, approval etc.
- Accelerator guys doing an incredible job
  doubled the data in one year !

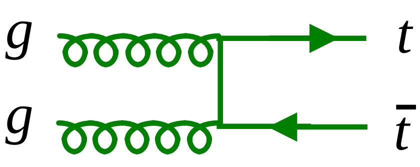


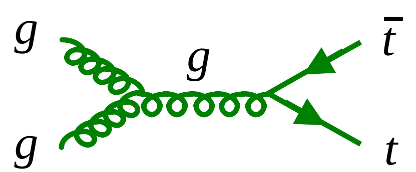
SM tt production

Production via strong interaction:

- qq annihilation
- gluon fusion





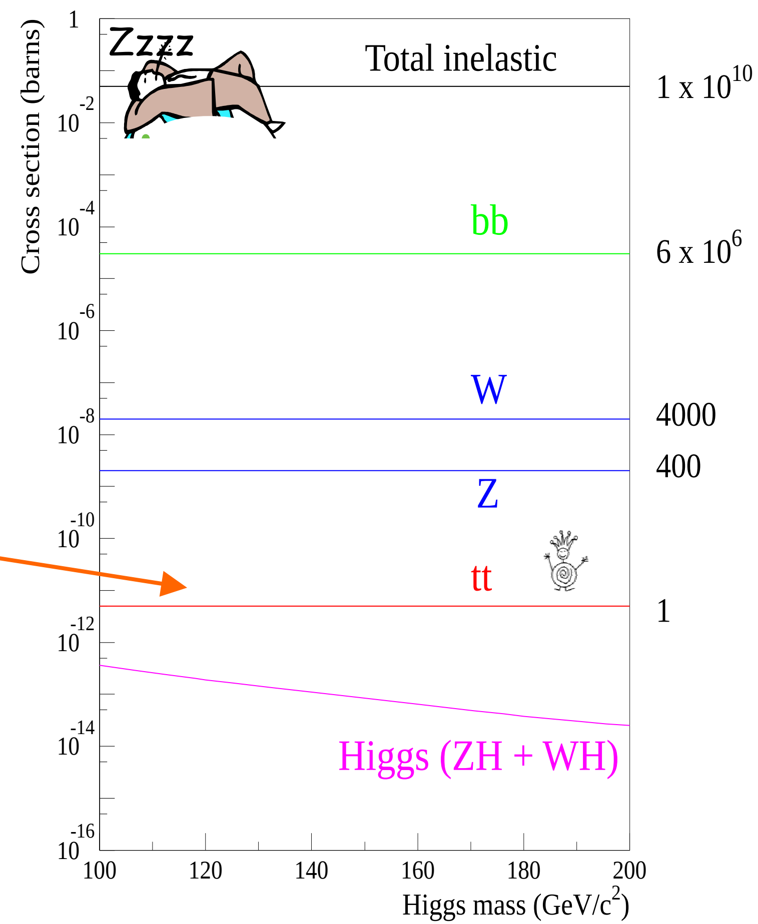


√s [TeV]	σ [pb]	qq %	gg %	Rate
1.96	$6.7^{+0.7}_{-0.9}$	85	15	~1/hr
14	800±100	10	90	~1/2 s

Theoretical predictions at ~10% uncertainty.

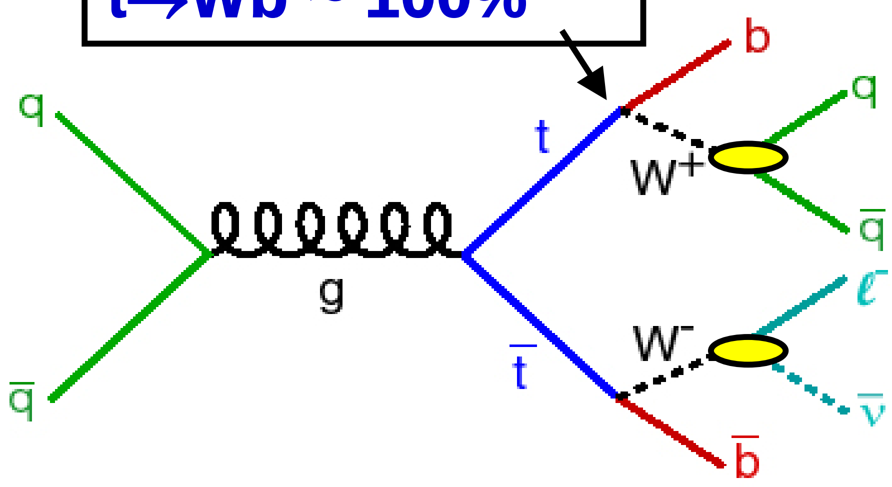
Uncertainties due to renormalization/factorization scale, parton distribution functions and how to deal with higher order corrections

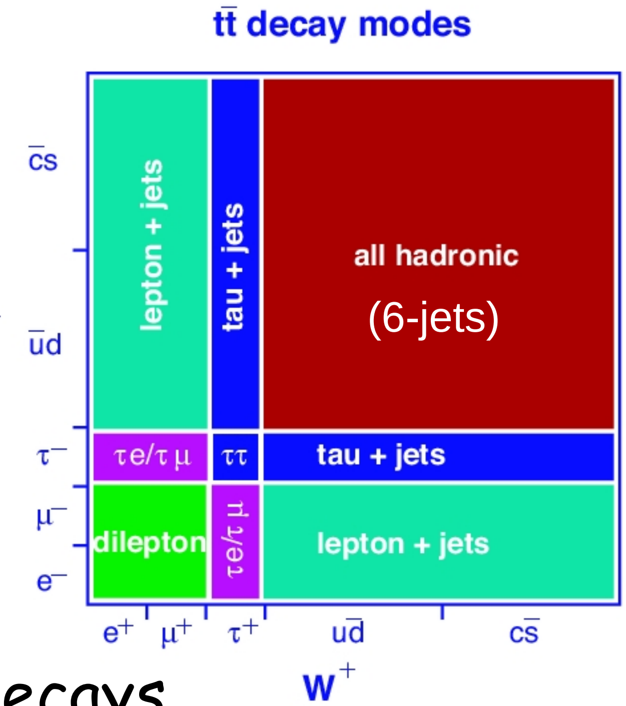
Physic processes yields at the Tevatron



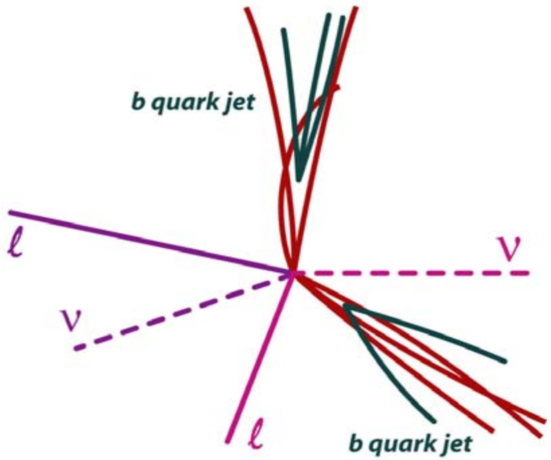
Final states from tt

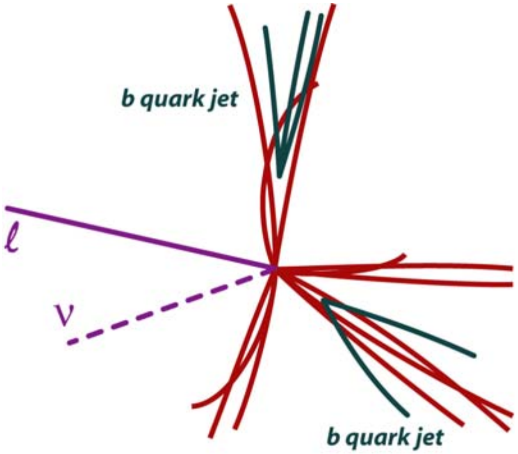
Standard Model:
t→Wb ~ 100%

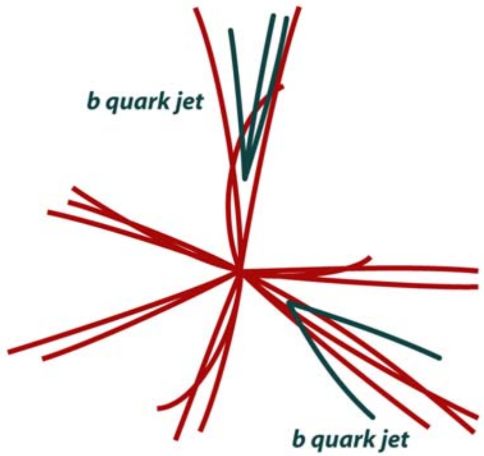




Final state determined by the W decays





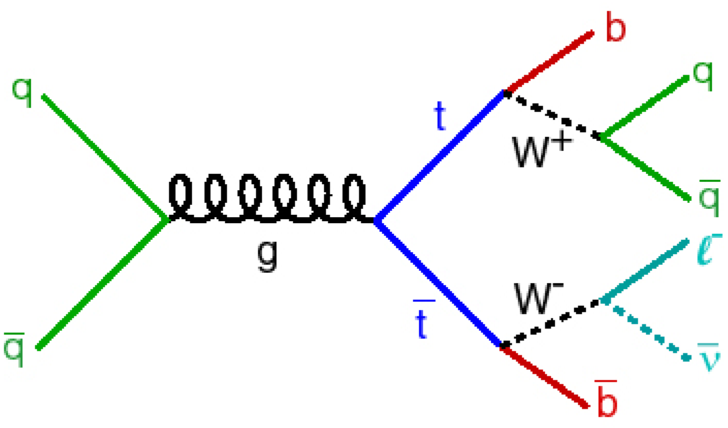


Lepton+jets channel

We present results on the lepton+jets channel

- Dilepton: yield is ~5 times smaller (small number of events)
- All hadronic: large QCD backgrounds

ttbar decay channel	Branching Ratio	Features
Dilepton	5%	High Purity Low yield
Lepton+Jets	30%	Good Purity Good yield
All Hadronic	44%	Lower Purity Better yield

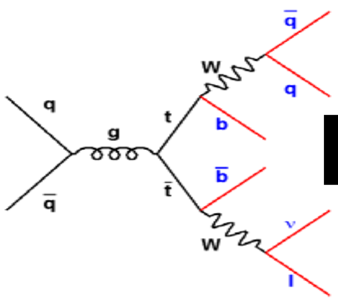


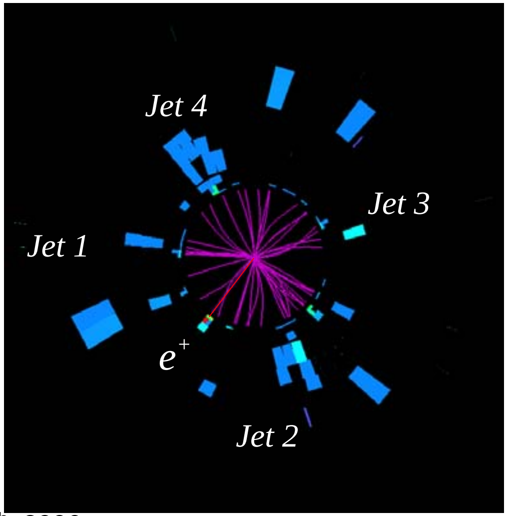
Lepton + Jets overall best choice for *Mttbar* reconstruction.

tt event reconstruction in the lepton+jets channel

To reconstruct [accurately] any kinematical variable for the tt system we need:

- All final state particle momenta
- All measured as precisely as possible





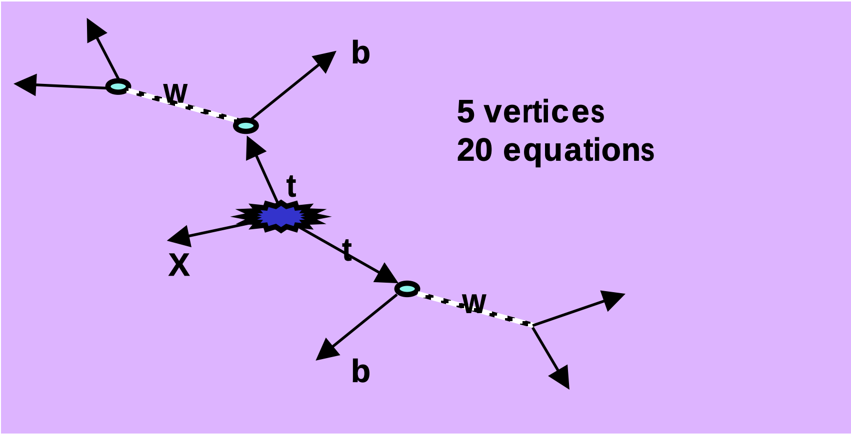
In the l+jets final state:

- Neutrino's longitudinal momentum not known
- Its transversal momentum reconstructed indirectly
- Jet energy is measured with limited precision (~20%)
- Don't know which jet goes with which parton
- Further complicated by extra jets/energy from initial and final state radiation

lepton+jets event reconstruction using kinematics

"standard" technique, since top "evidence era", to measure the Top mass

- Use lepton + 4 jets and measure:
  - lepton, MET, jet1, jet2, jet3, jet4, X
  - correct jets to parton level
- Constrained kinematically: 2C-fit



– tags are associated to b-quarks
– several combinatorical solutions:
– 24 if no b's, 12 if 1 b-tag, 4 if 2 tags
– both solutions for the neutrino P_z are considered
– solution with best χ^2 selects the most likely kinematical configuration

$$\chi^2 = \sum_{\ell,jets} \frac{(\hat{P}_T - P_T)^2}{\sigma^2_{P_T}} + \sum_{i=x,y} \frac{(\hat{U}_i^! - U_i^!)^2}{\sigma^2_{U_i^!}} + \frac{(M_{\ell\nu} - M_W)^2}{\sigma^2_{M_W}} + \frac{(M_{jj} - M_W)^2}{\sigma^2_{M_W}} + \frac{(M_{\ell\nu j} - M_t)^2}{\sigma^2_{M_t}} + \frac{(M_{jjj} - M_t)^2}{\sigma^2_{M_t}}.$$

particles	unknowns
t's	7
X	2
W's	6
b's	0
q's	0
lep	0
ν	3
TOT	18

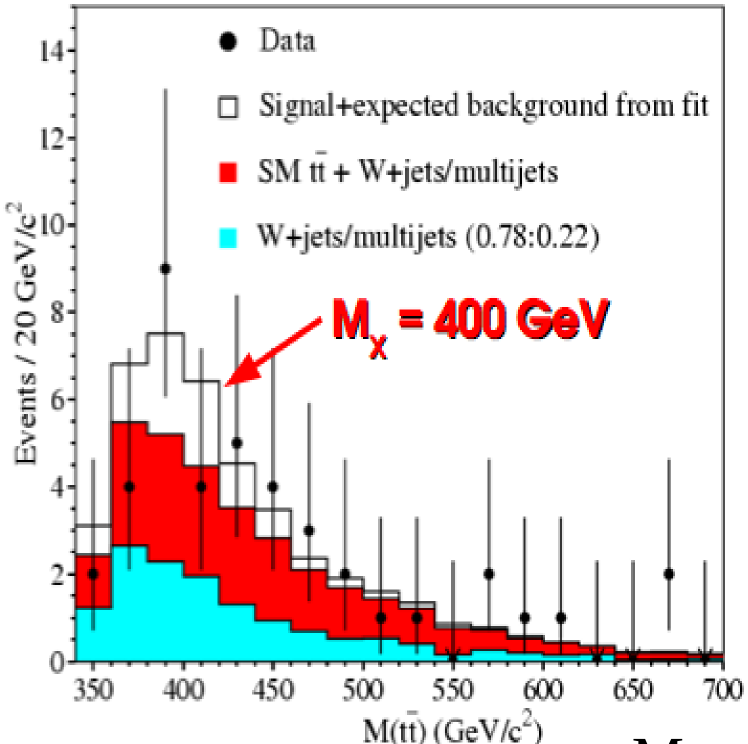
$$\vec{P}_T(t\bar{t} + X) = 0$$
$$M_{l\nu} = M_W$$
$$M_{j_1,j_2} = M_W$$
$$M_{t_1} = M_{t_2}$$

Assuming Mtop can also be used to reconstruct Mtt

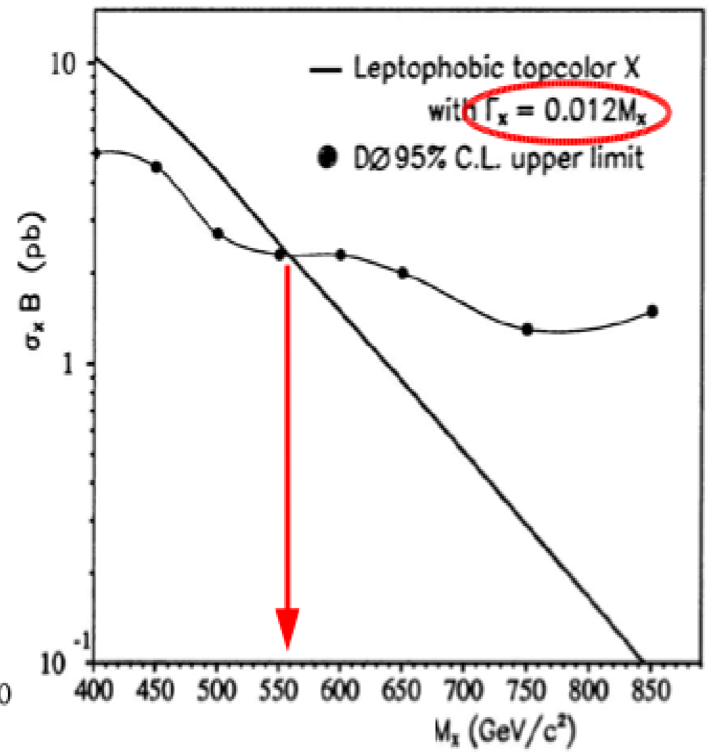
D0 Run I Results on Mtt

Phys. Rev. Lett. 92, 221804 (2004)

Luminosity = 130 pb^{-1}
N = 41 events



$M_{t\bar{t}}$

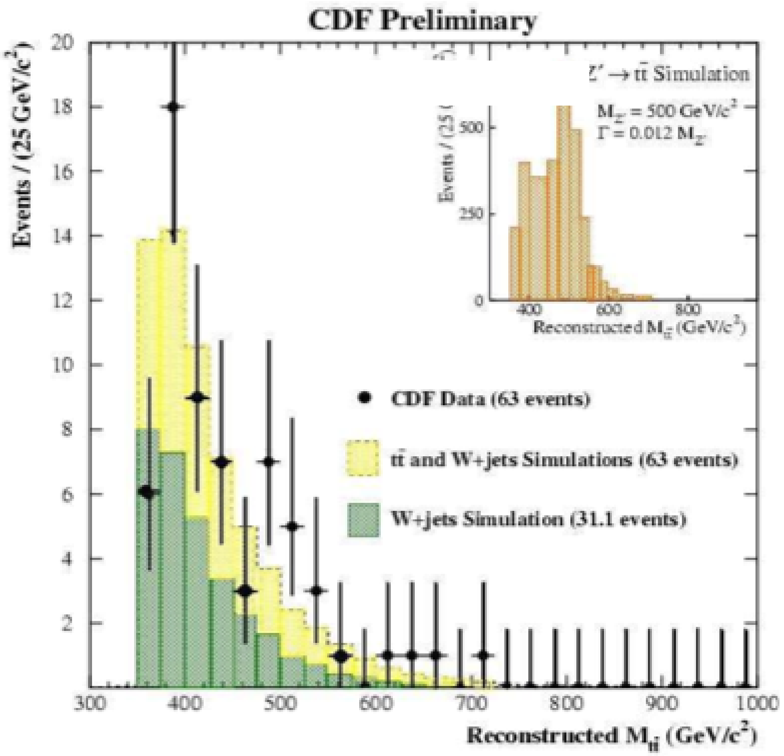


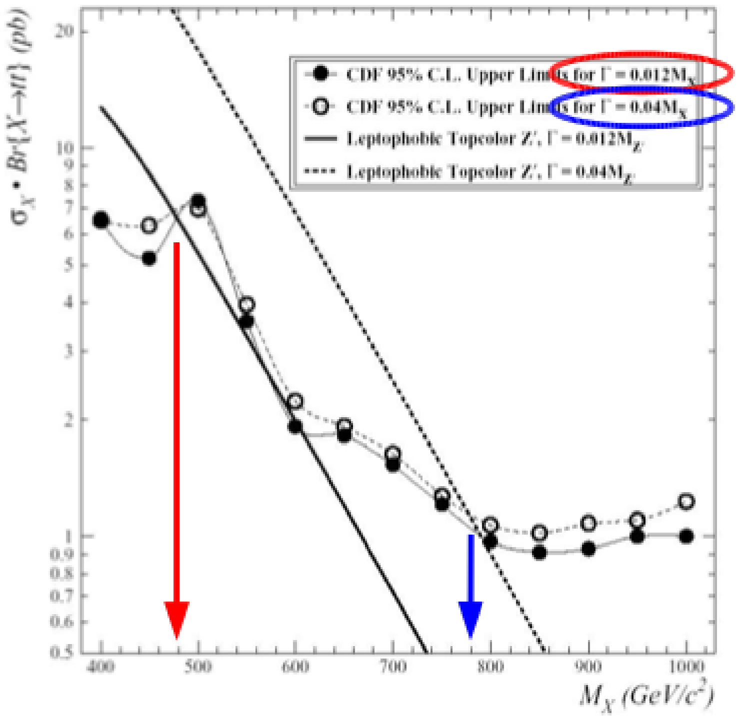
M_x > 540 GeV , $\Gamma_x = 0.012M_x$
Leptophobic topcolor

CDF Run I Results on Mtt

Phys. Rev. Lett. 85, 2062 (2000)

Luminosity = 109 pb^{-1}
N = 63 events





$M_{t\bar{t}}$

M_x > 480 GeV　　M_x > 780 GeV

$\Gamma_x = 0.012M_x$　　$\Gamma x = 0.04Mx$

Leptophobic topcolor

Another way: Mtt via Matrix Element

- Use dynamical information to find the probability for any parton level final state, given the observables (leptons, jets, met)
  - Exploits maximal information in the event

$$dP(\mathbf{p}) \propto \text{PDF} \cdot d\sigma \cdot \text{TF}$$

- Incoming Parton Distribution Functions.
- $d\sigma$: differential cross section for a production process of interest, i.e. pp→tt.
- Transfer Functions: probabilistic relation between measured jet energy and parton momentum
- **p**: parton level final state.
  - from which we can build the probability for any kinematical variable, e.g. Mtt

Matrix Element for Mtt

- What we want:
  - Posterior probability of the parton distribution:

$$\pi^{post}(p_b, p_{\bar{b}}, p_q, p_{\bar{q}}, \vec{p_\nu} | \vec{j_1}, \vec{j_2}, \vec{j_3}, \vec{j_4}, \vec{p_l})$$

$$\pi^{post}(\{p\}|\{j\}) \propto \pi^{prior}(\{p\}) \cdot T(\{j\}|\{p\})$$

- The posterior Mtt probability density is:

$$\rho^{post}(x|\{j\}) = \int \{dp\} \pi^{post}(\{p\}|\{j\}) \cdot \delta(x - M_{t\bar{t}}(\{p\}))$$

  - We sum over all combinations

- We define the reconstructed Mtt per event as the average of the distribution $\rho^{post}(x \mid \mathbf{j})$

$$\mathcal{M}_{t\bar{t}} = < \rho^{post}(x|\{j\}) >$$

This implementation

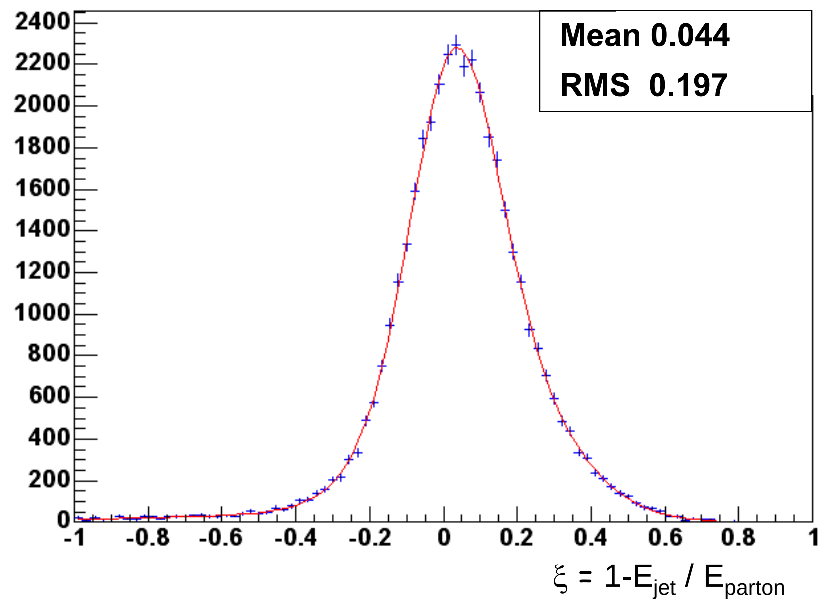
dσ calculation

- We use the 2 --> 6 exact tree level ME for all relevant diagrams:
  - q-qbar and all three gg diagrams for SM ttbar
- Spin-correlations are included
- We compute complex amplitudes directly using explicit Dirac matrices and spinors

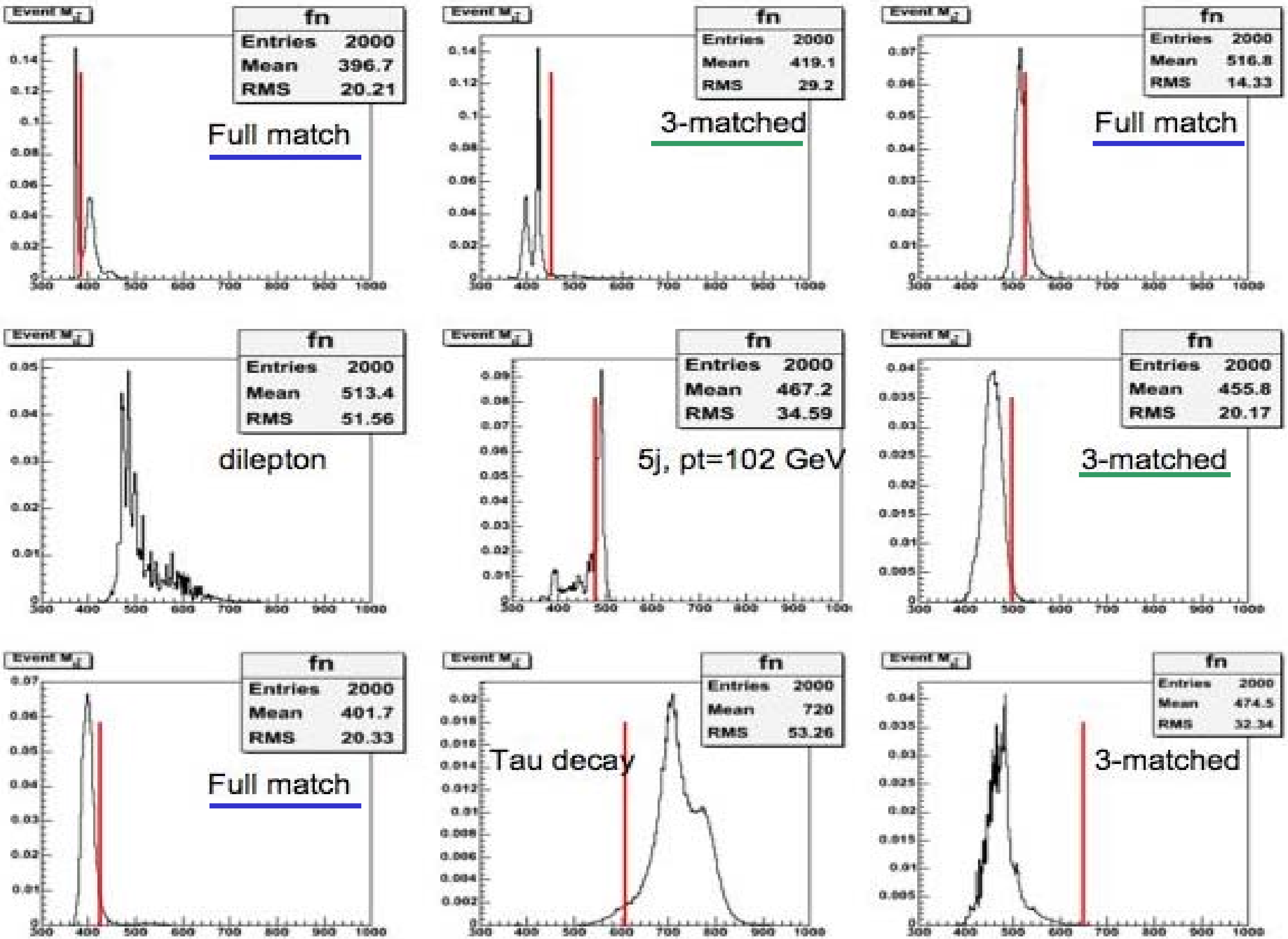
$$\mathcal{M}_{q\bar{q}} \sim \; p_{\bar{q}})\gamma^{\mu}u(p_q)\cdot\bar{u}(p_u)\gamma^{\beta}(1-\gamma^5)v(p_{\bar{d}})\cdot\bar{u}(p_l)\gamma^{\sigma}(1-\gamma^5)v(p_{\bar{\nu}})\cdot$$
$$p_b)\gamma^{\alpha}(1-\gamma^5)\frac{\not{p}_t+m_t}{p_t^2-m_t^2+im_t\Gamma_t}\gamma^{\nu}\frac{\not{p}_{\bar{t}}+m_t}{p_{\bar{t}}^2-m_t^2+im_t\Gamma_t}\gamma^{\rho}(1-\gamma^5)v(p_{\bar{b}})\cdot$$
$$\frac{g_{\mu\nu}}{(p_q+p_{\bar{q}})^2}\cdot\frac{g_{\alpha\beta}-P_{\alpha}^{W^+}P_{\beta}^{W^+}/m_W^2}{P_{W^+}^2-m_W^2+im_W\Gamma_W}\cdot\frac{g_{\rho\sigma}-P_{\rho}^{W^-}P_{\sigma}^{W^-}/m_W^2}{P_{W^-}^2-m_W^2+im_W\Gamma_W}$$

Transfer Functions

- From MC simulation calculate the probability density function $TF(E_j|E_p)$
  - $\xi = 1 - E_{jet} / E_{parton}$



Example of event Mtt distributions

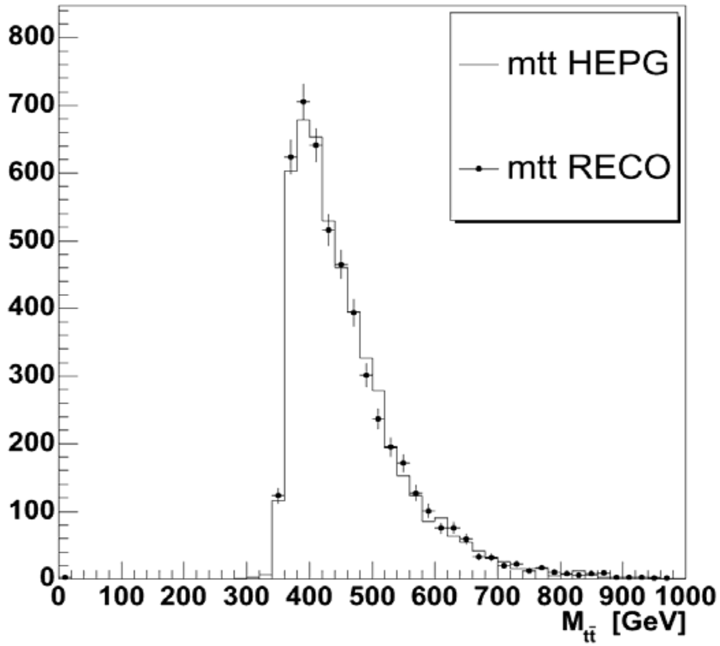


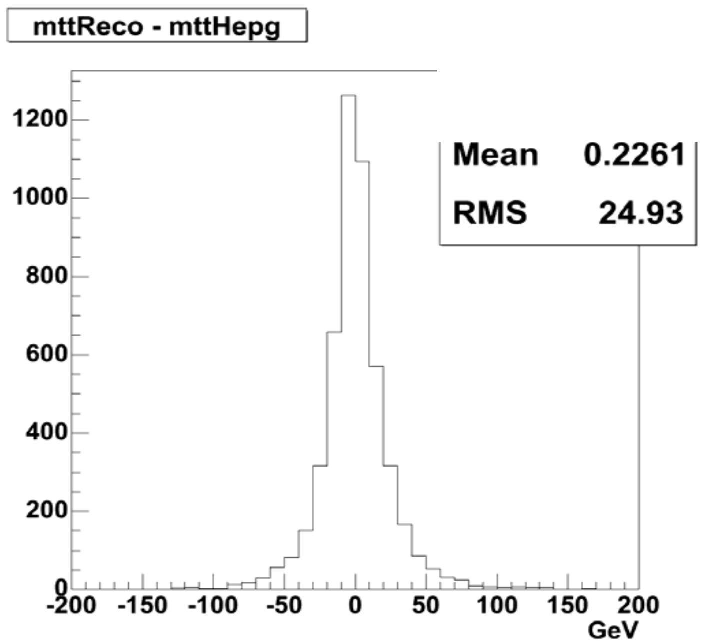
Red line: input event resonance mass.

SM ttbar: ME-reconstructed Mtt spectrum

- Monte Carlo comparison between generated and reconstructed Mtt
  - L+4j event selection applied
  - correct parton-jet combination

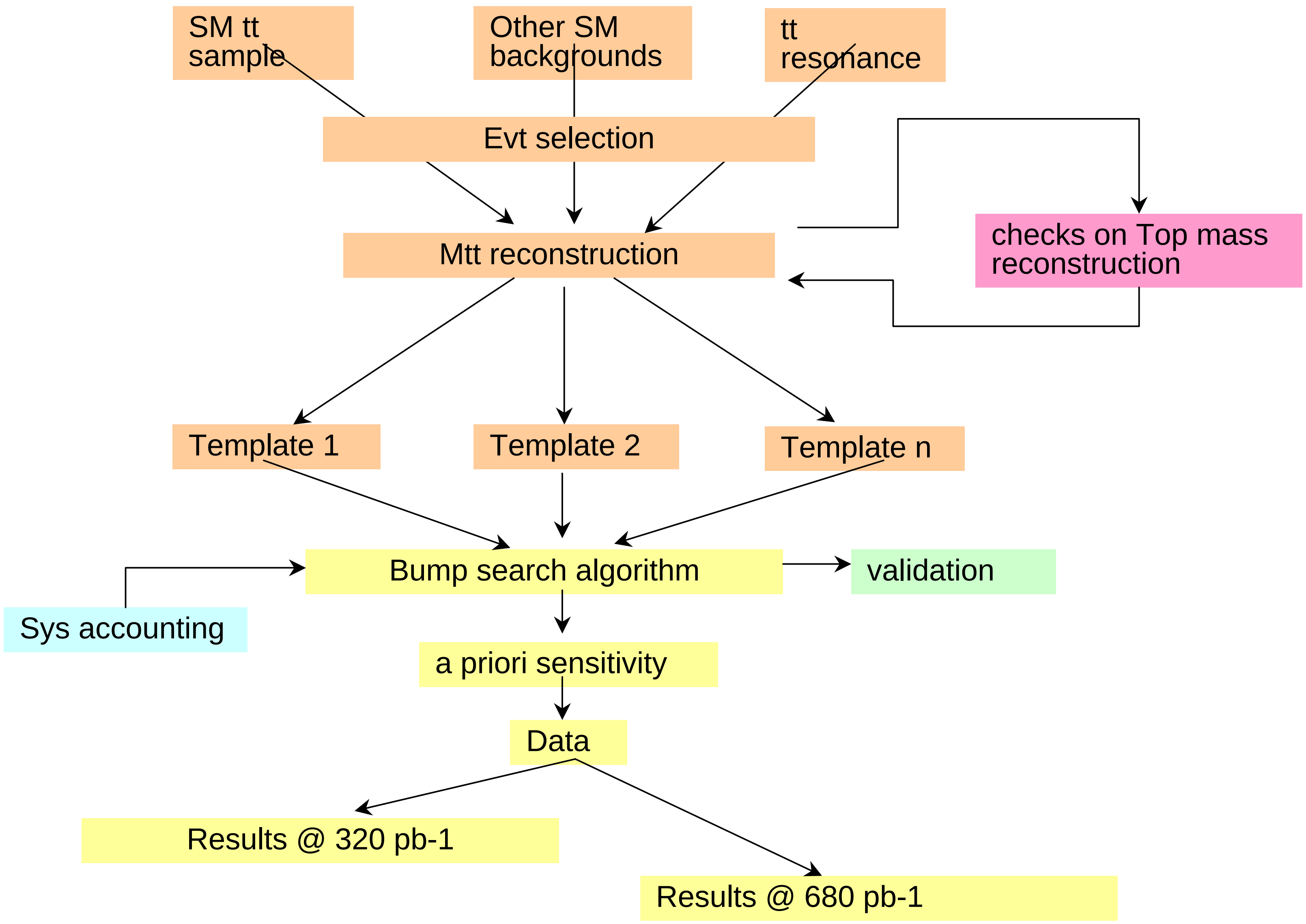
$$\mathcal{M}_{t\bar{t}} = < \rho^{post}(x|\{j\}) >$$





SM Mtt is reconstructed back to the parton distribution

Analysis Path



Monte Carlo Samples & Event Selection

Standard Model background Samples

- SM ttbar [Pythia]
- W+4p (W → e, mu) [Alpgen]
- W+2b+2p (W → e, mu) [Alpgen]
- Dibosons WW, WZ, ZZ [Pythia]
- QCD from data

Resonant tt signal samples

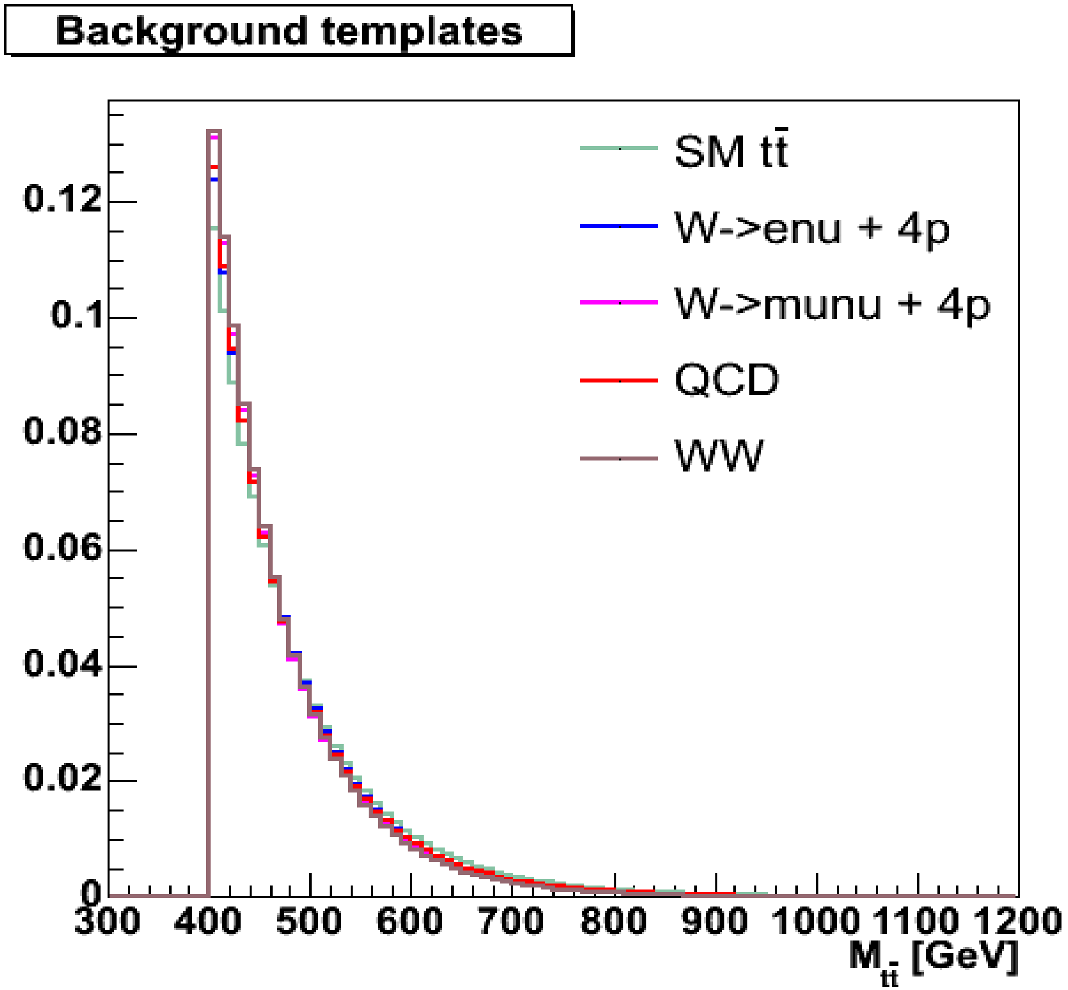
- Xo {450, 500, 550, 600, 650, 700, 750, 800, 850 & 900} GeV [Pythia]
  - GEANT based CDF simulation

Event Selection, same as CDF top cross section:

- 1 Lepton: Pt>20GeV, $|\eta|<1.0$
- $\geq$4 jets: Et>15GeV, $|\eta|<2.0$
- $E_T^{miss} > 20$GeV
- remove: Z, conversions, cosmics

Standard Model Mtt templates

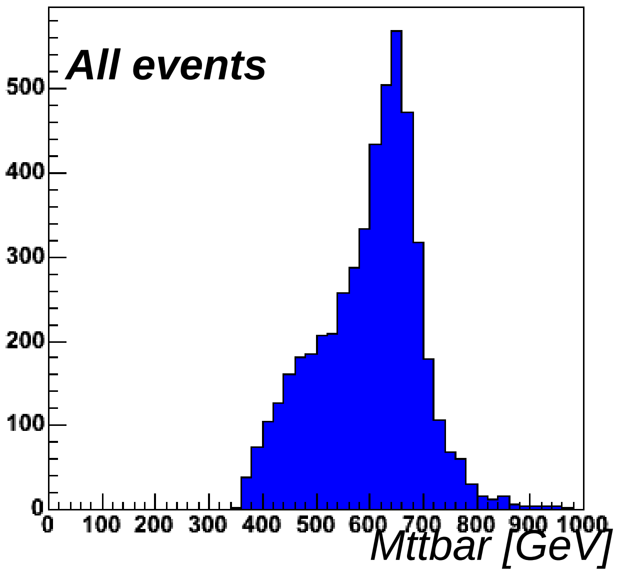
- A priori decided to perform a resonance search only above 400 GeV.
- The spectrum shape of the Standard Model backgrounds are very similar.

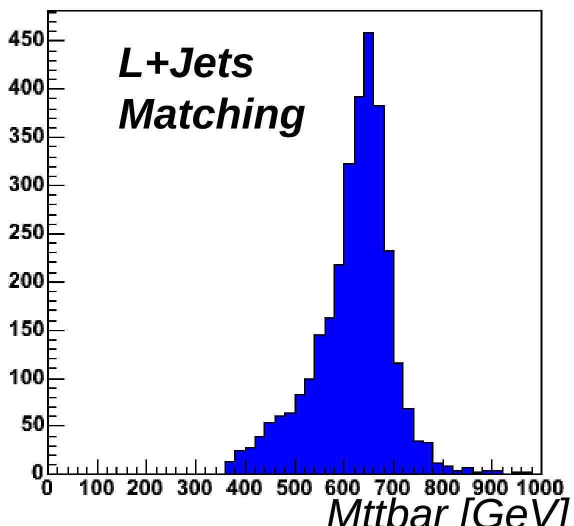


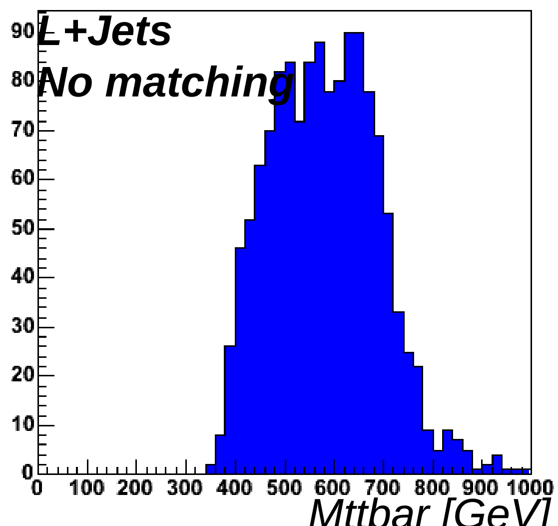
Reconstructed Mtt from resonant production

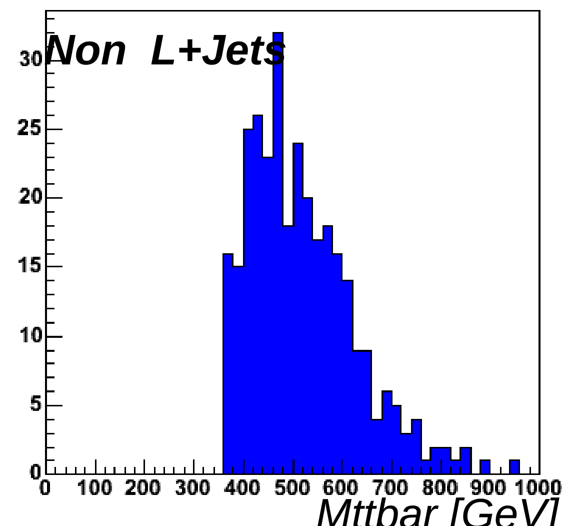
- The resonance spectrum is made up of three distinct components:
  - True Lepton+Jets events :
    - All partons are matched to jets
    - Not all partons are matched
  - Events from other tt channels
    - Mostly dileptons

M(X)=650 GeV

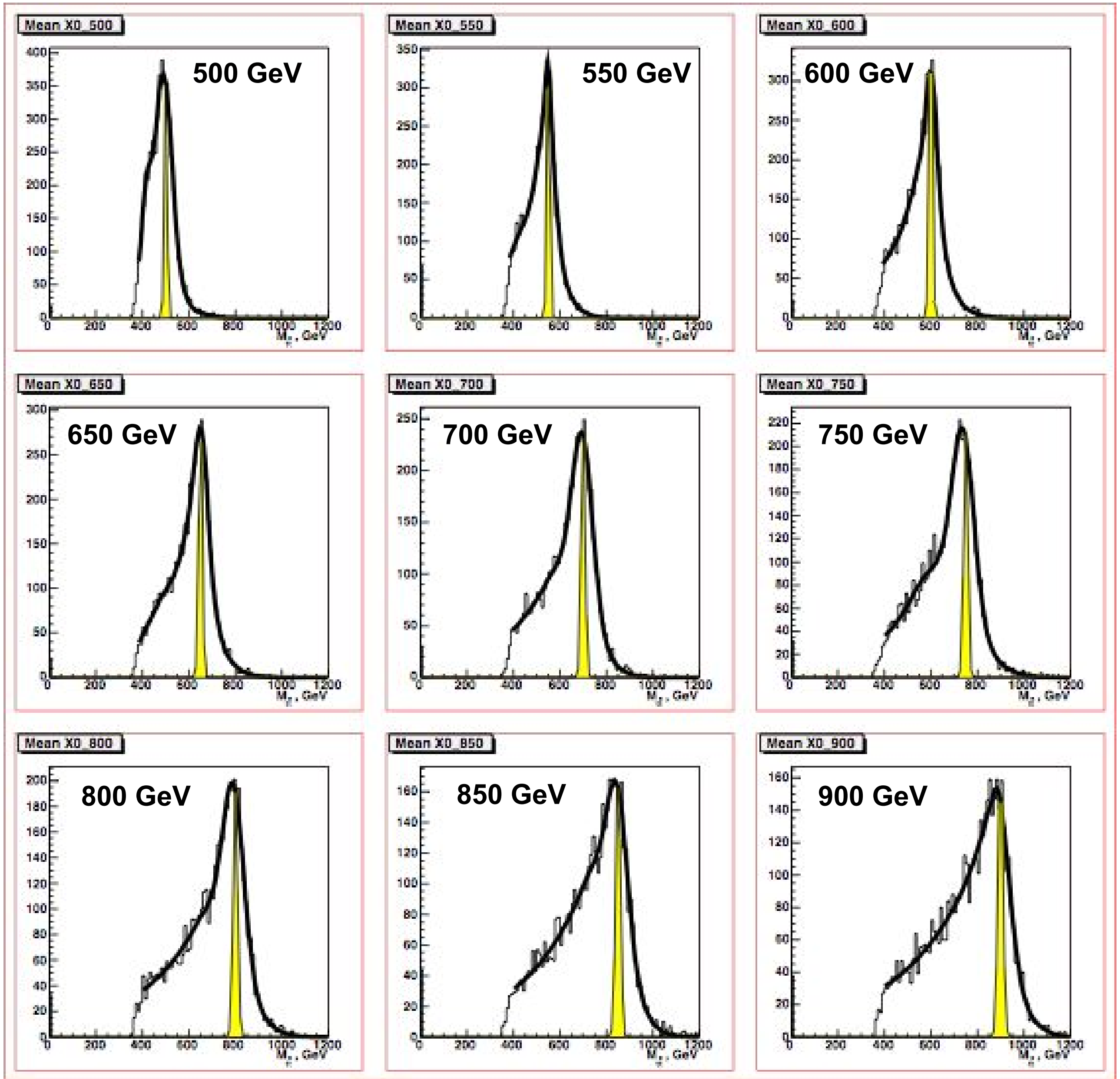






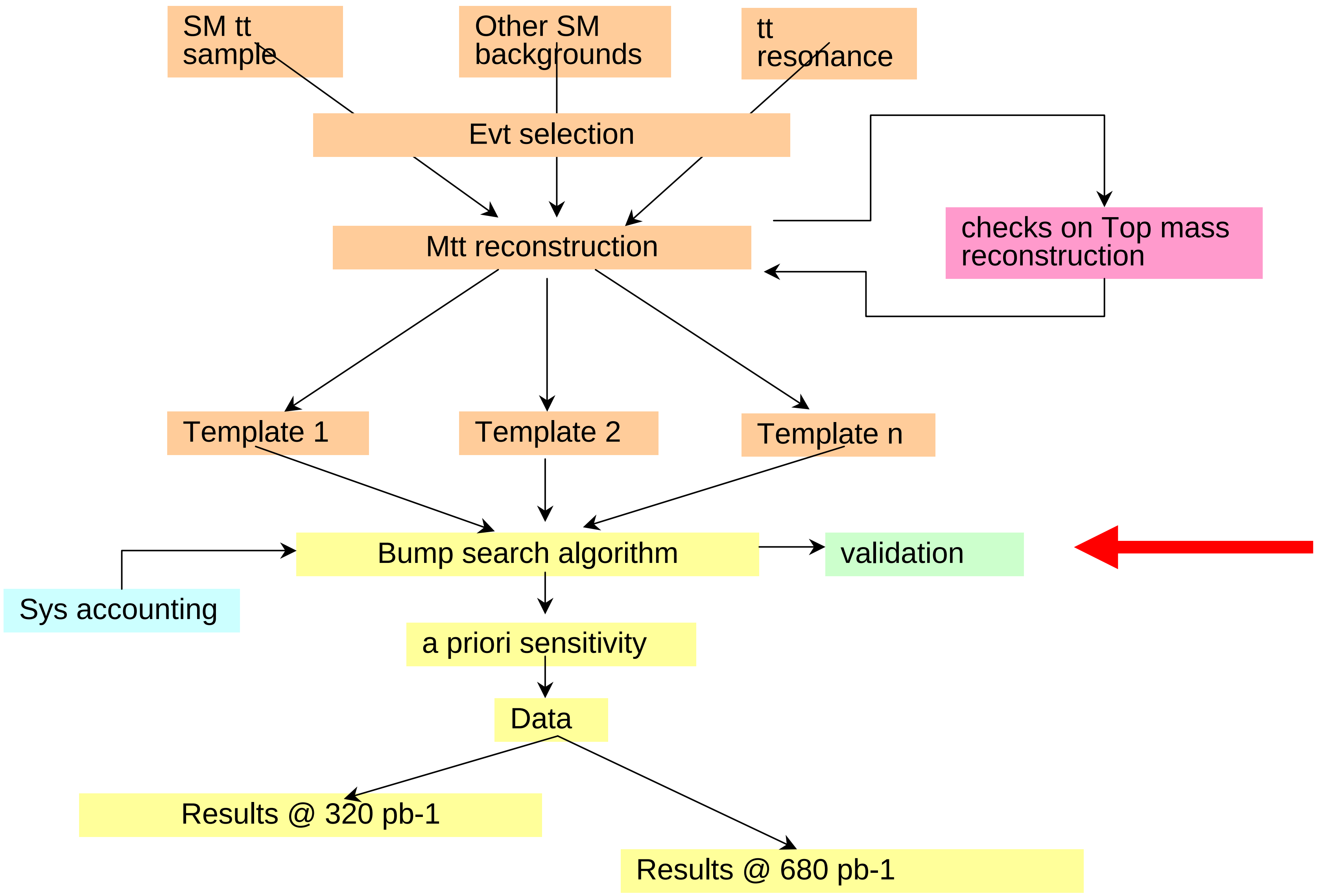


Resonances with different masses



Reconstructed width is independent of intrinsic resonance width [for narrow resonances <5%]

Analysis Path



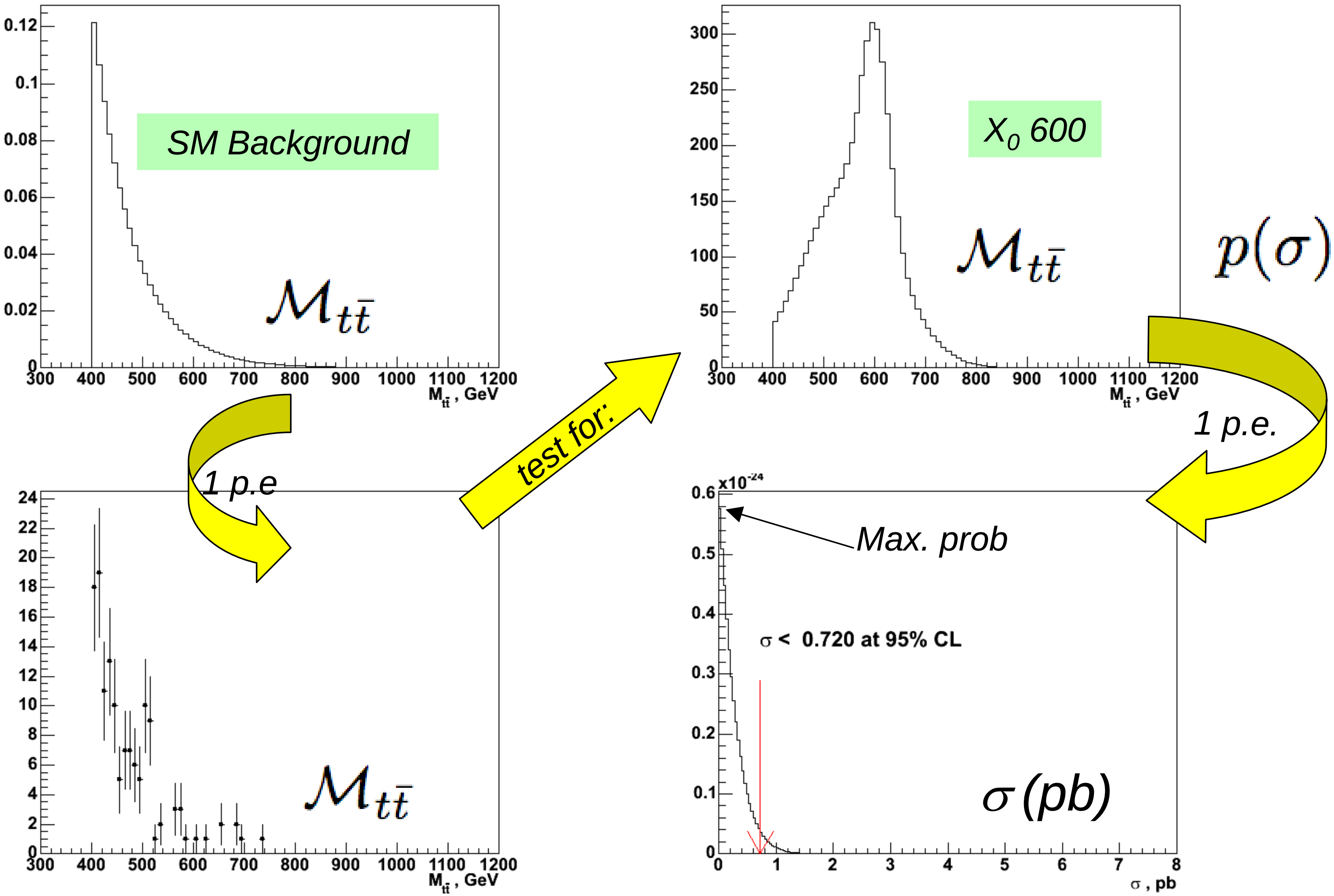
The Question

- How sensitive are we to the presence of signal from a narrow resonance in the Mtt distribution?
  - when is a bump a fluctuation and when it is not?
- Developed a "bump search" procedure able to:
  - Establish an a priori expected sensitivity to signal
  - Measure cross section if signal is present
  - Set a limit if not
  - Account for stat and syst uncertainties
- Assumptions:
  - no interference between BSM and SM signals
  - look for a narrow resonance ($\Gamma < 5\%$ M)
    - look for a vector resonance

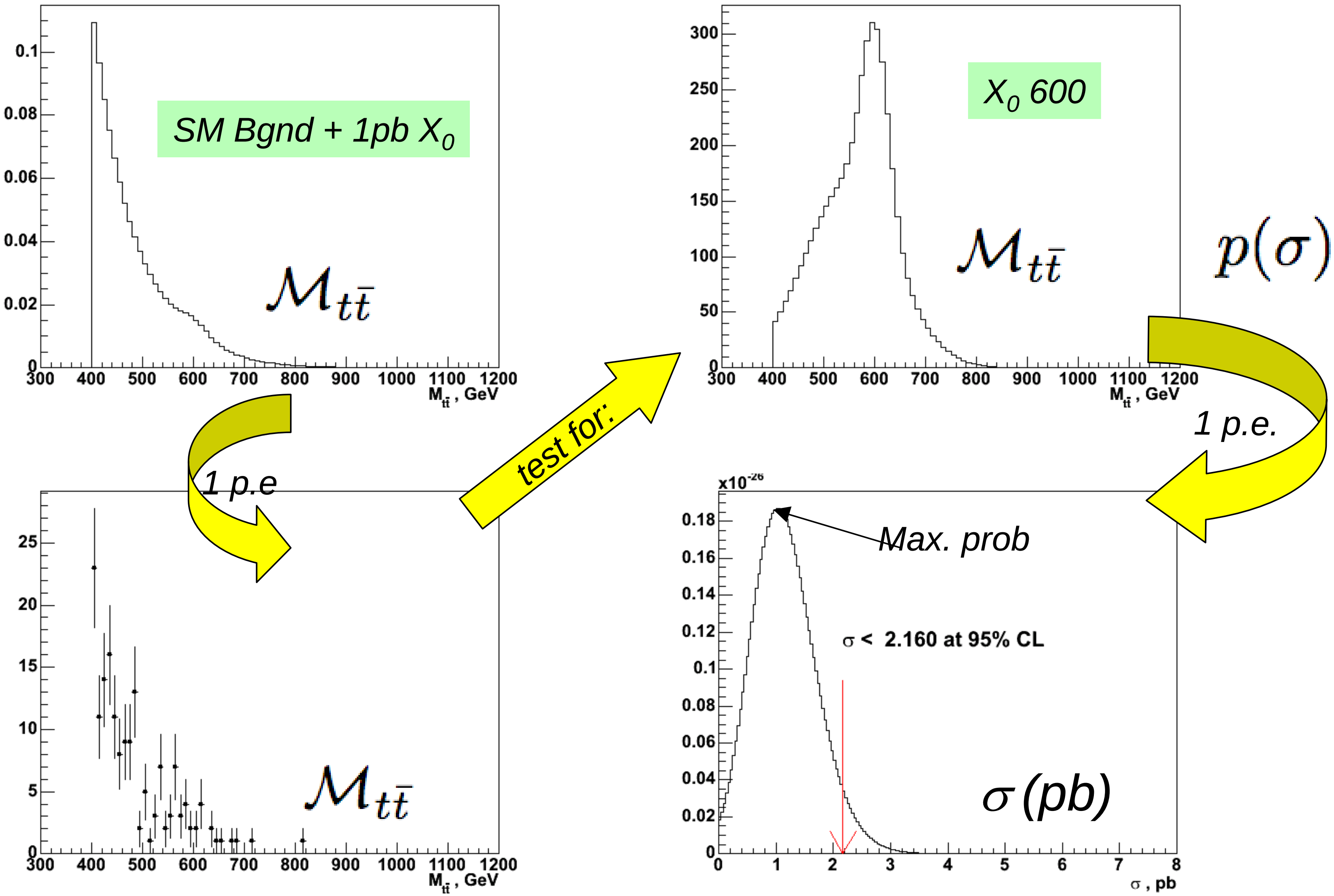
Search ingredients

- **Inputs:**
  - o Signal and background Mtt templates
  - o Signal and backgrounds relative weights
  - o Mtt reconstructed spectrum from fake/real experiment
- Test how compatible is the experiment with the hypothesis of the presence of signal (or not) in the data.
  - o Done for each resonance mass
- **Output:**
  - o For a given resonance mass return the probability distribution as a function of its cross section contribution to the experiment
- Run many simulated experiments ("pseudoexperiments") with SM event alone and with SM with signal added – see what we learn

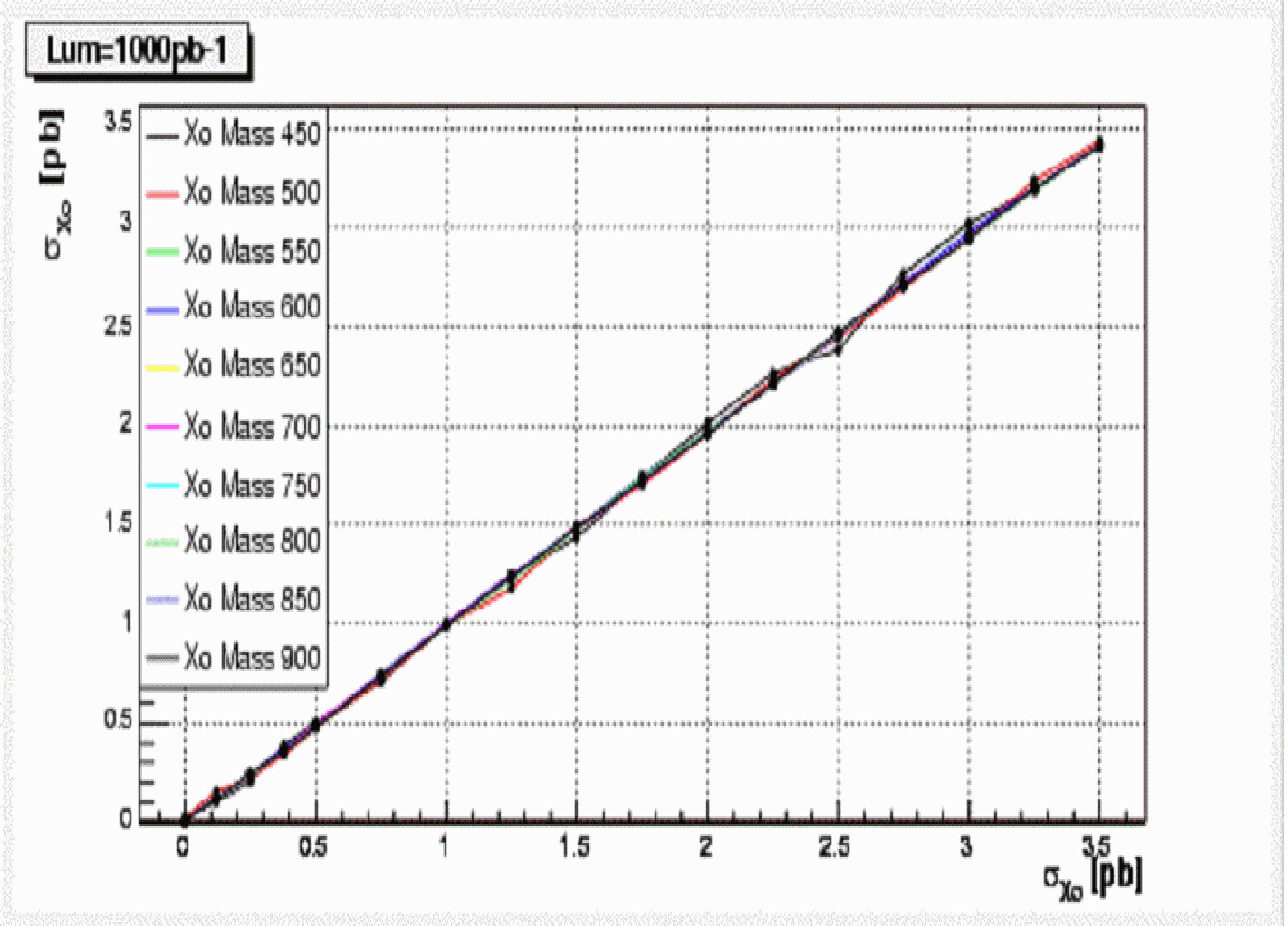
Example: pseudoexperiment without signal (319 pb^{-1})



Example: pseudoexperiment with 1pb signal (319 pb^{-1})



Validation: output vs input cross section



- We get back what we put in

Shape systematics

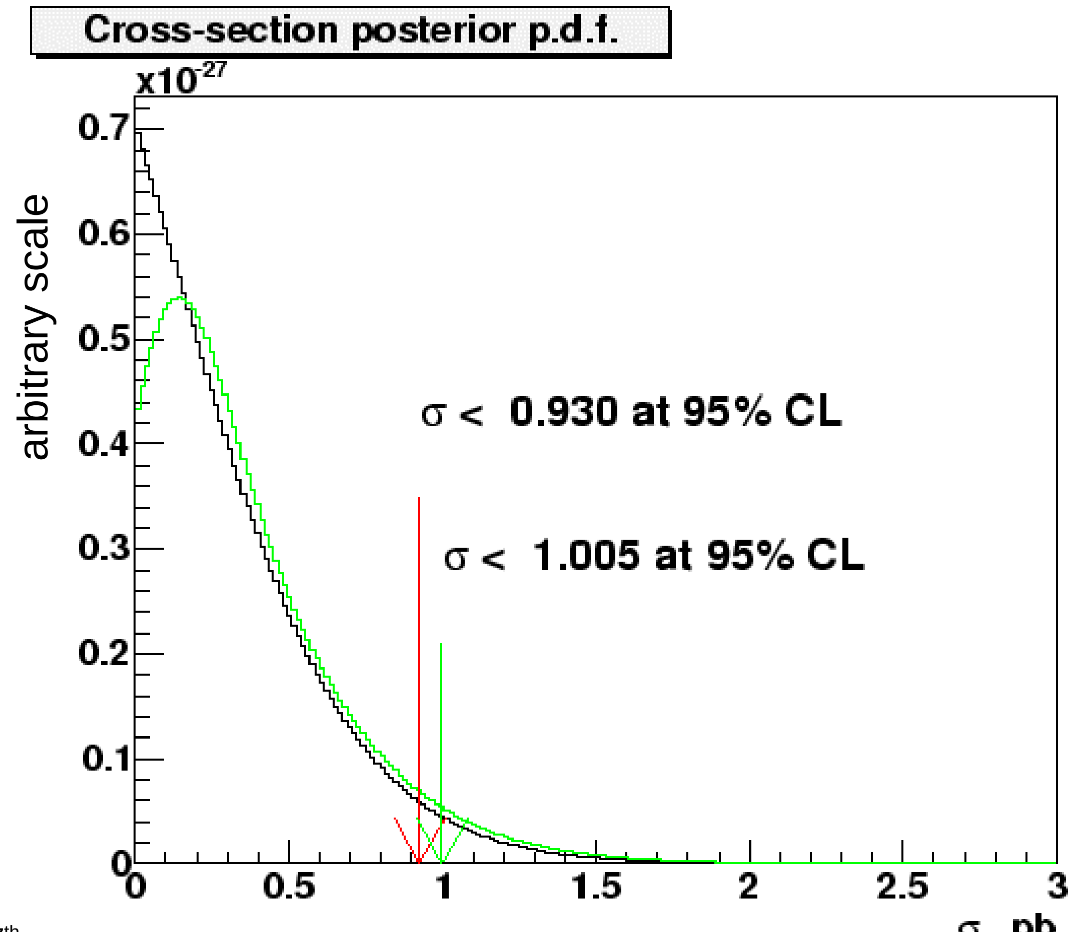
- **Shape systematics: template is changed**
  - If templates not quite correct the posterior may change
  - Xsec measurement (or limit estimation) shifted
- **Known systematics**
  - Jet energy scale
  - ISR/FSR
  - W-Q^2 scale
  - Parton Distribution Functions

Evaluate the shift as a function of the cross section and include it with a smearing function to the posterior.

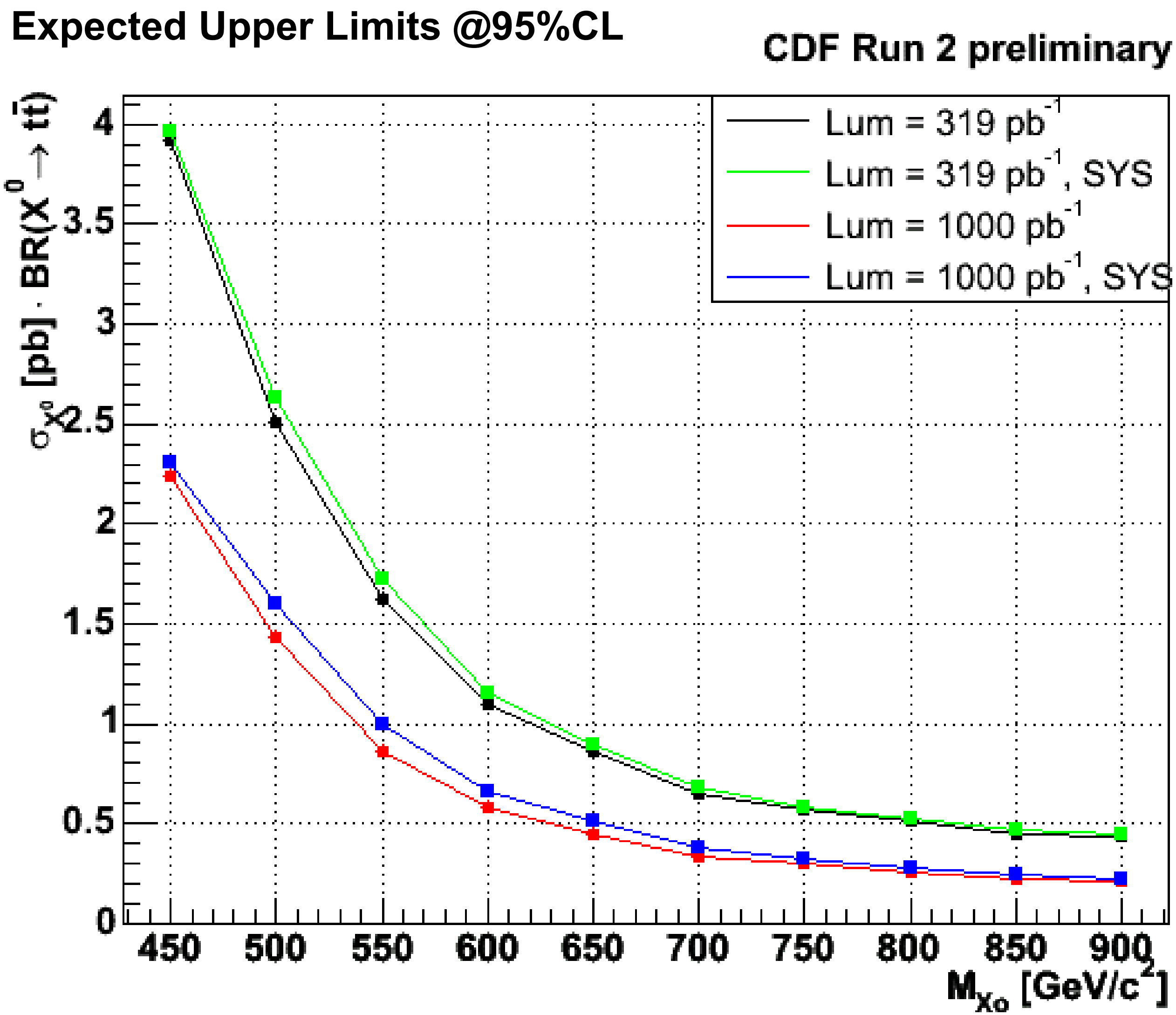
$$PDF_{SYS}(\sigma_{X_0}) = PDF \otimes \delta\sigma_{X_0} = \int_0^{\infty} G(\sigma_{X_0} - \sigma', \delta\sigma_{X_0}(\sigma_{X_0} - \sigma'))\, PDF(\sigma') \cdot d\sigma'$$

Apply cross section shift on posterior PDF

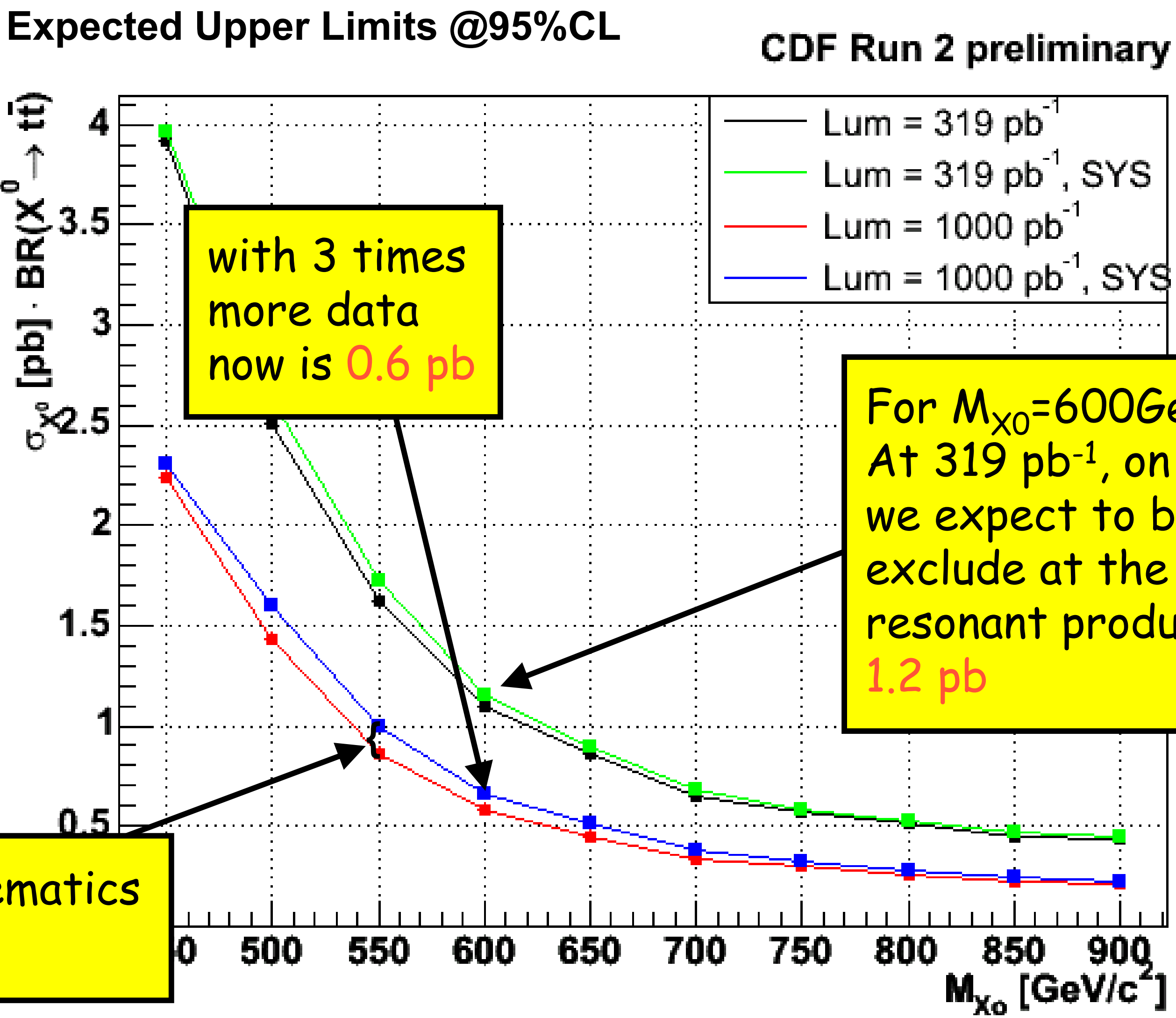
- Posterior obtained includes the systematics.
- New UL can be calculated



Expected sensitivity



Expected sensitivity

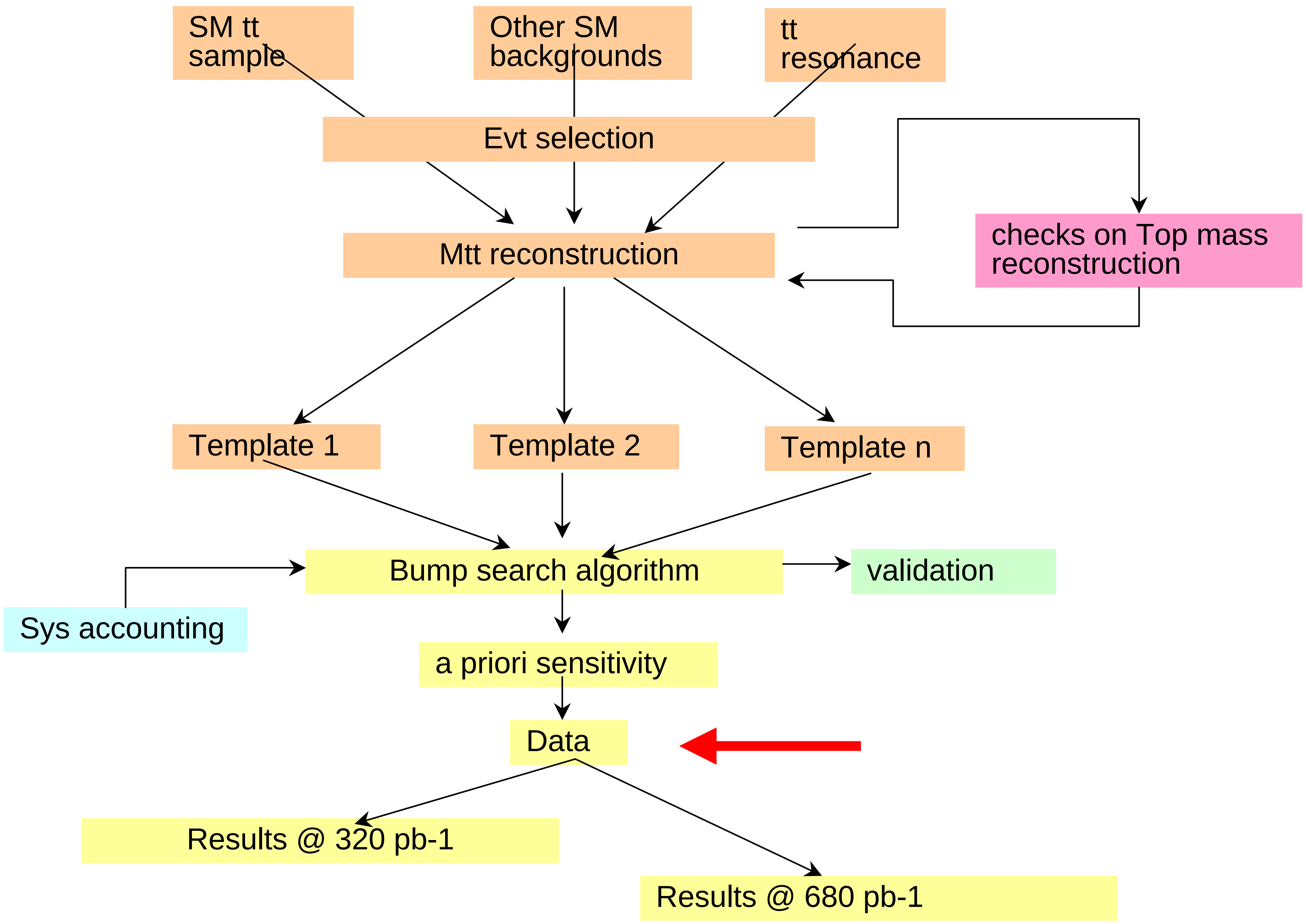


with 3 times more data now is 0.6 pb

For M_{X0}=600GeV
At 319 pb^{-1}, on average, we expect to be able to exclude at the 95% CL resonant production above 1.2 pb

shape systematics are small

Analysis Path



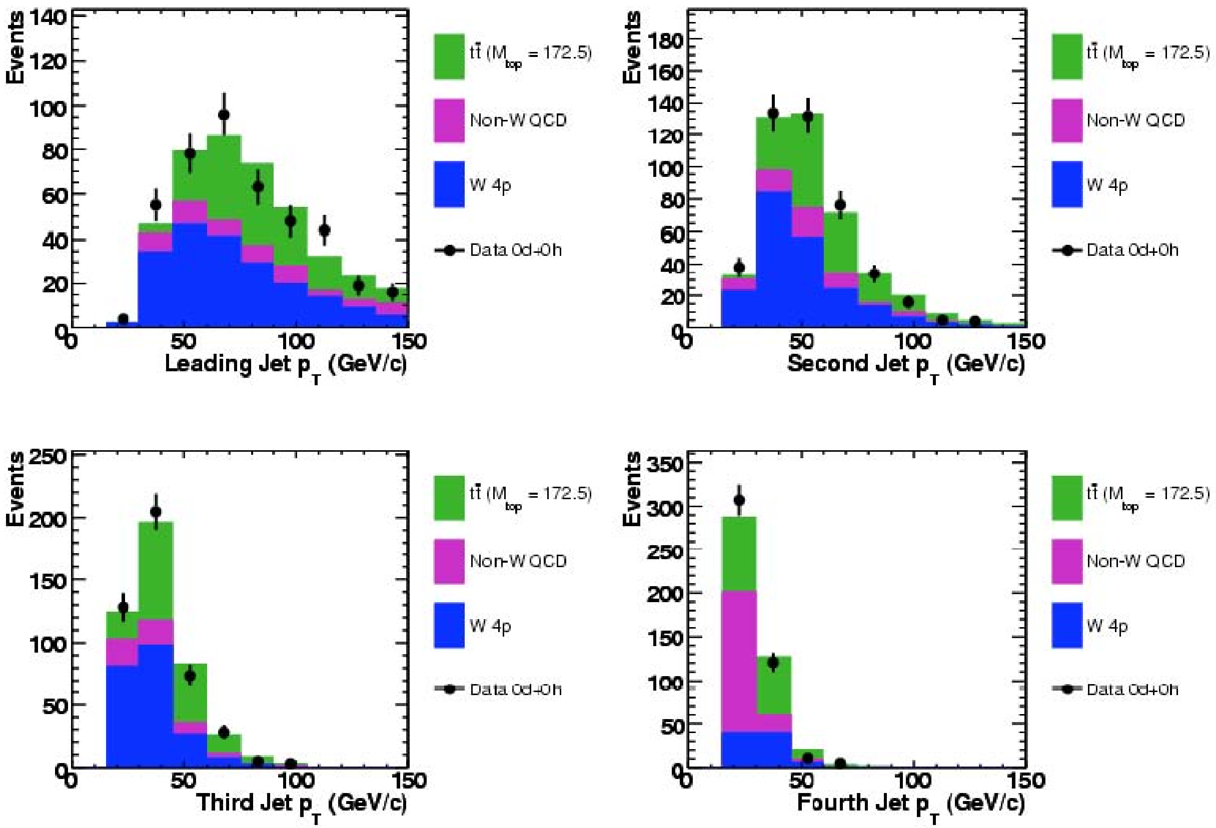
Analysis of the CDF data

- Use high-Pt electron and muon samples
  - trigger is >= 18 GeV
  - 320 pb^{-1} up until aug 2004 – public result
  - 680 pb^{-1} presented here
- Offline, apply "W+jets" selection
  - 1 Lepton: Pt>20GeV, $|\eta|<1.0$
  - $E_T^{miss} > 20GeV$
  - ≥4 jets: Et>15GeV, $|\eta|<2.0$
  - remove: Z, conversions, cosmics
  - no-tag required (used in algorithm if available)
- Sample composition
  - SM top & di-bosons from theory
  - Ratio of QCD multijet to W+jets from CDF's tt cross section measurement using kinematical variables
  - Balance to the observed data is W+jets + any resonance

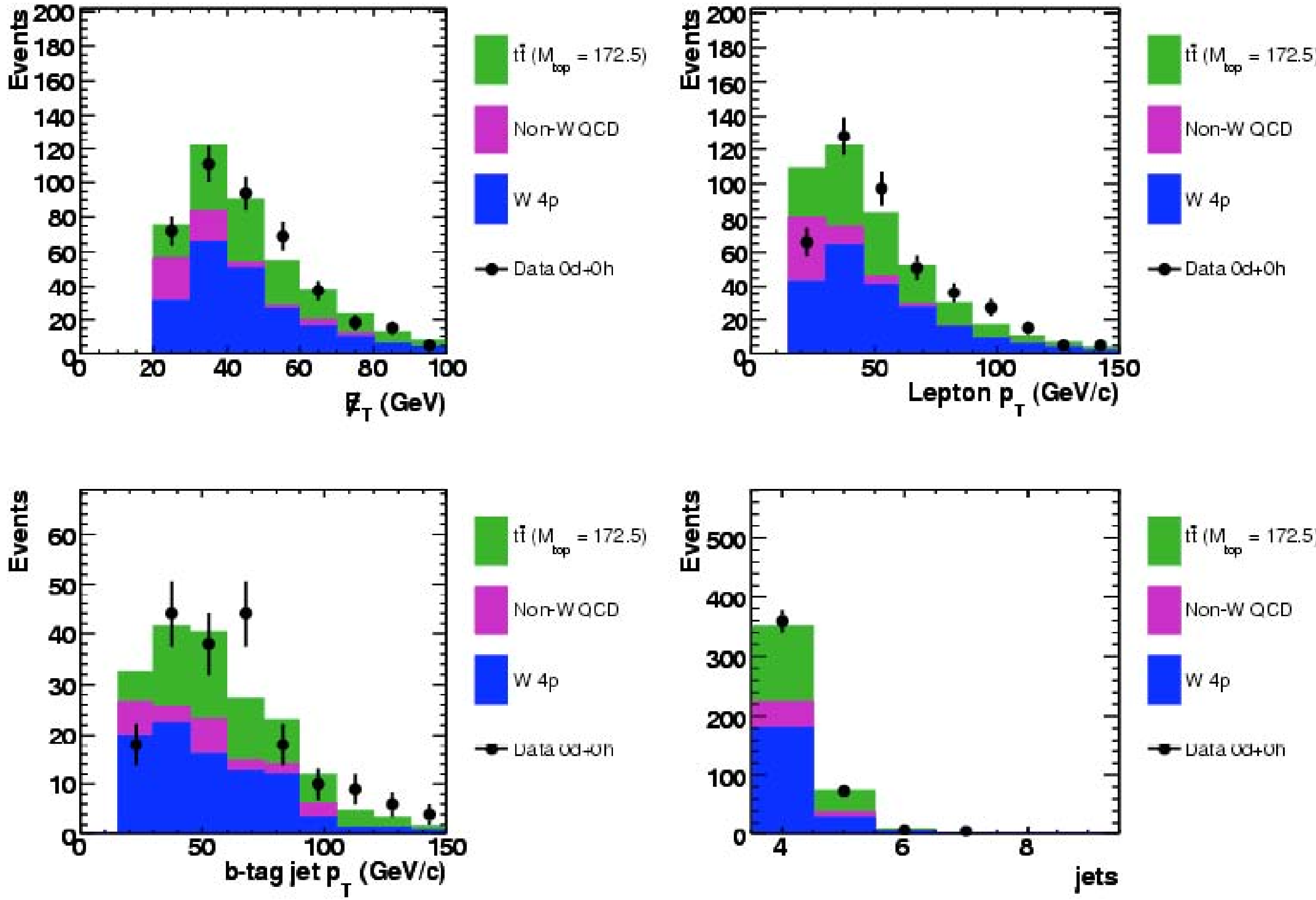
W+4-jets sample composition

Some distributions for 682 pb^{-1}

→ sample composition is understood well

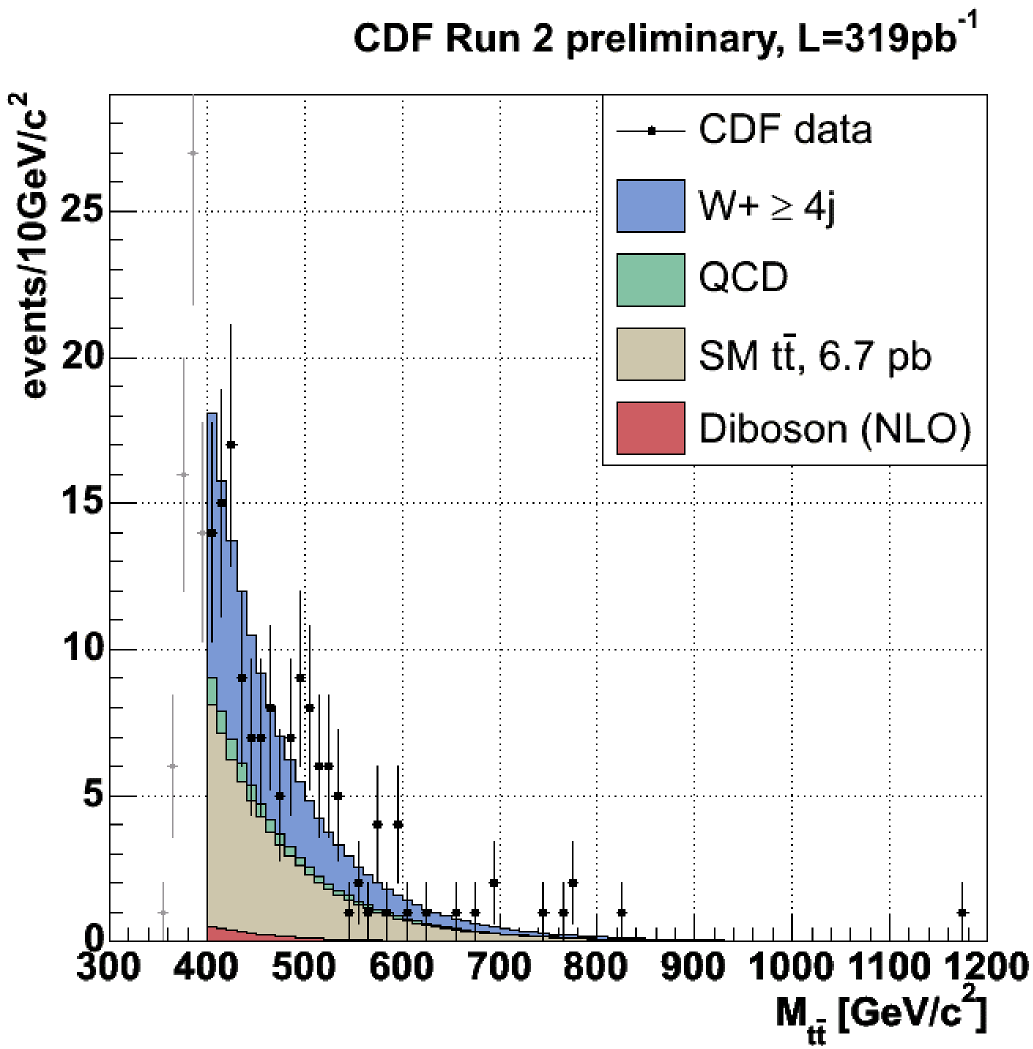


W+4-jets sample composition

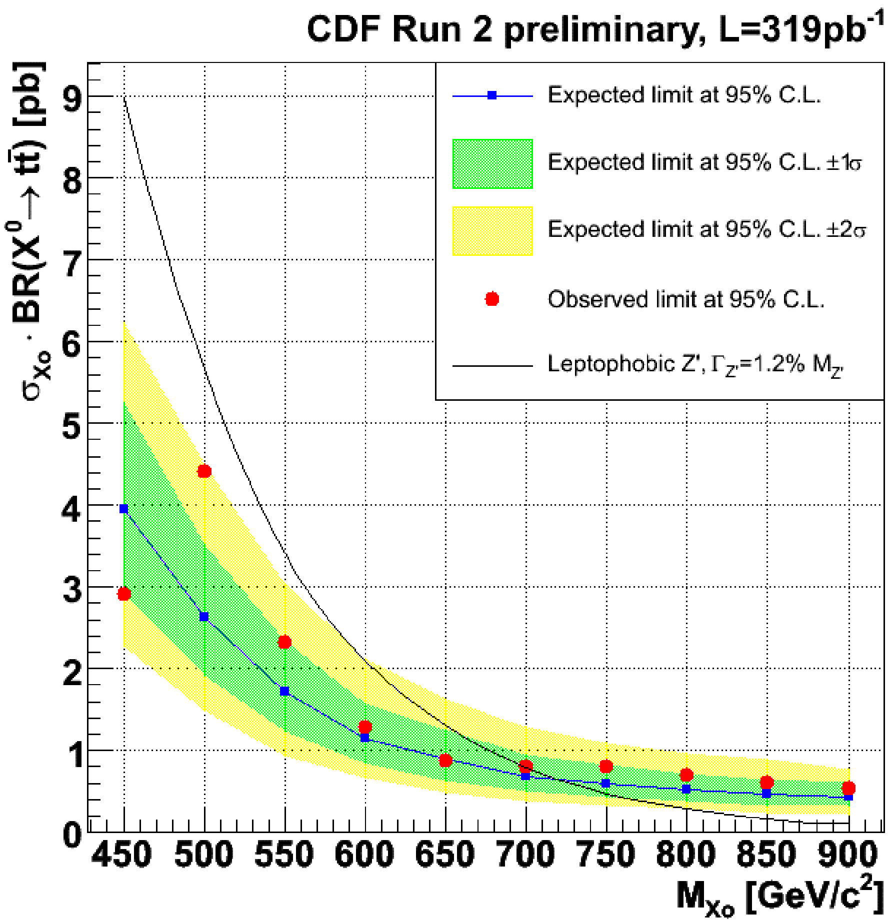


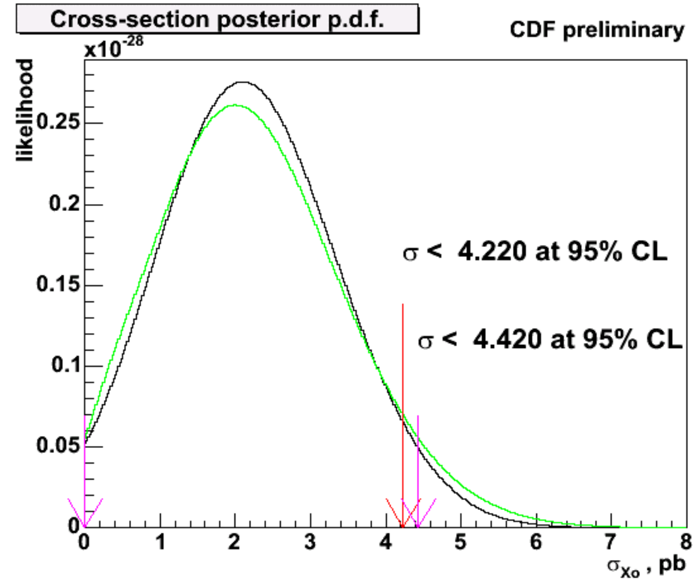
Reconstructed Mtt from 319 pb^{-1} data

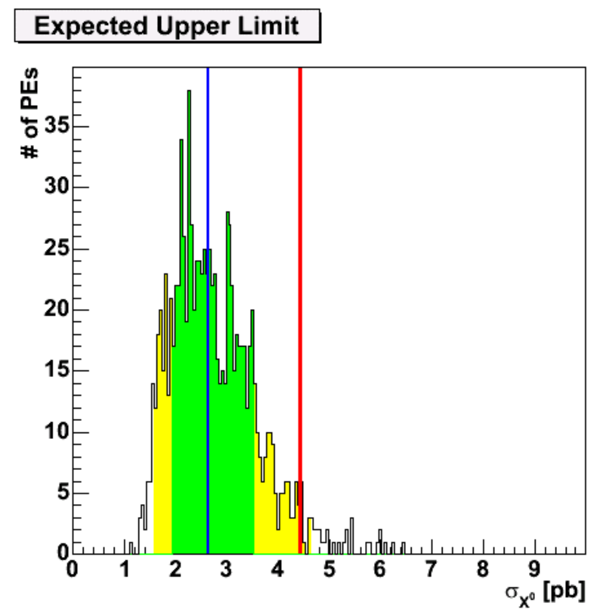
Data vs SM expectation



Bump search results on 319 pb-1

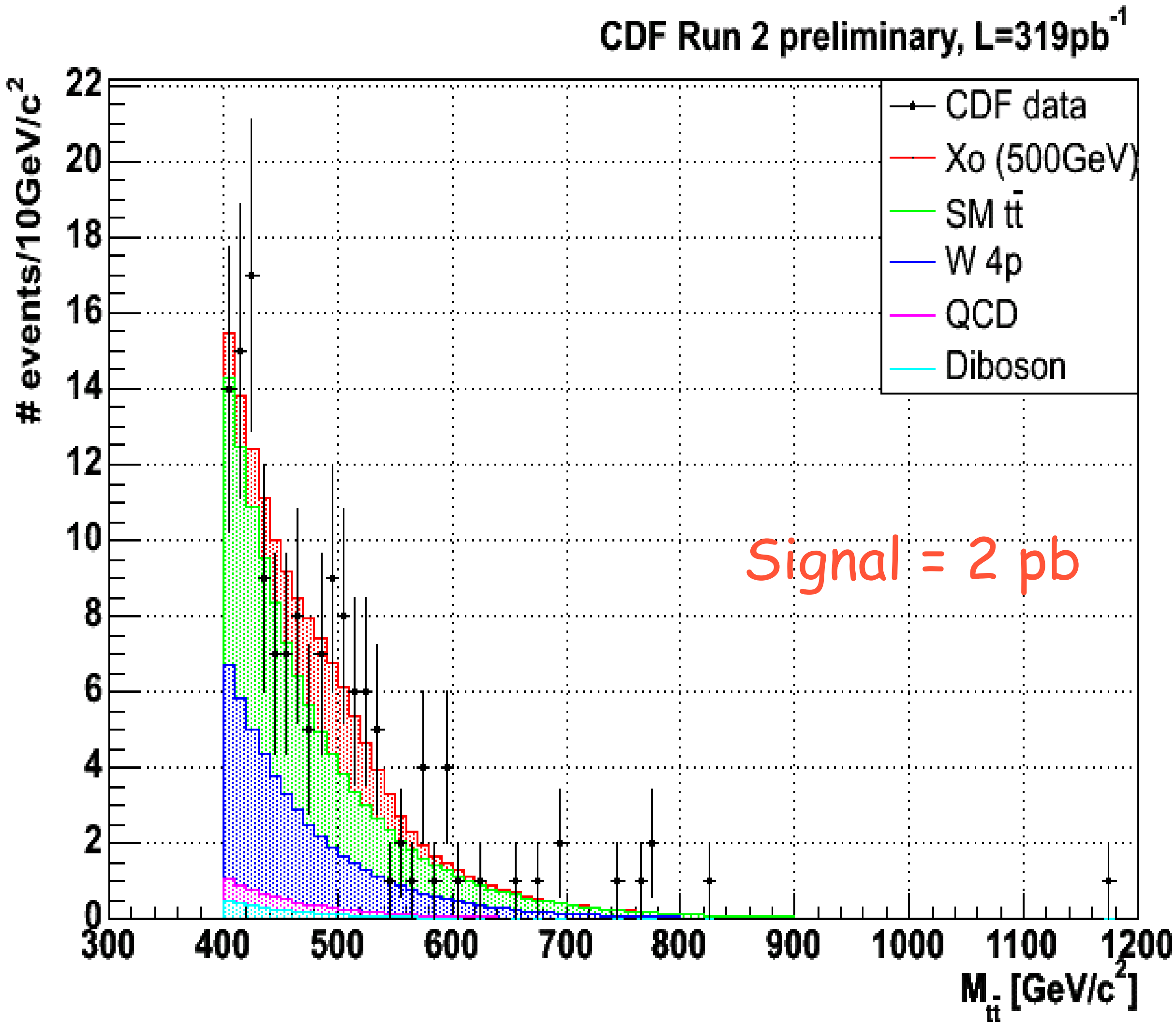






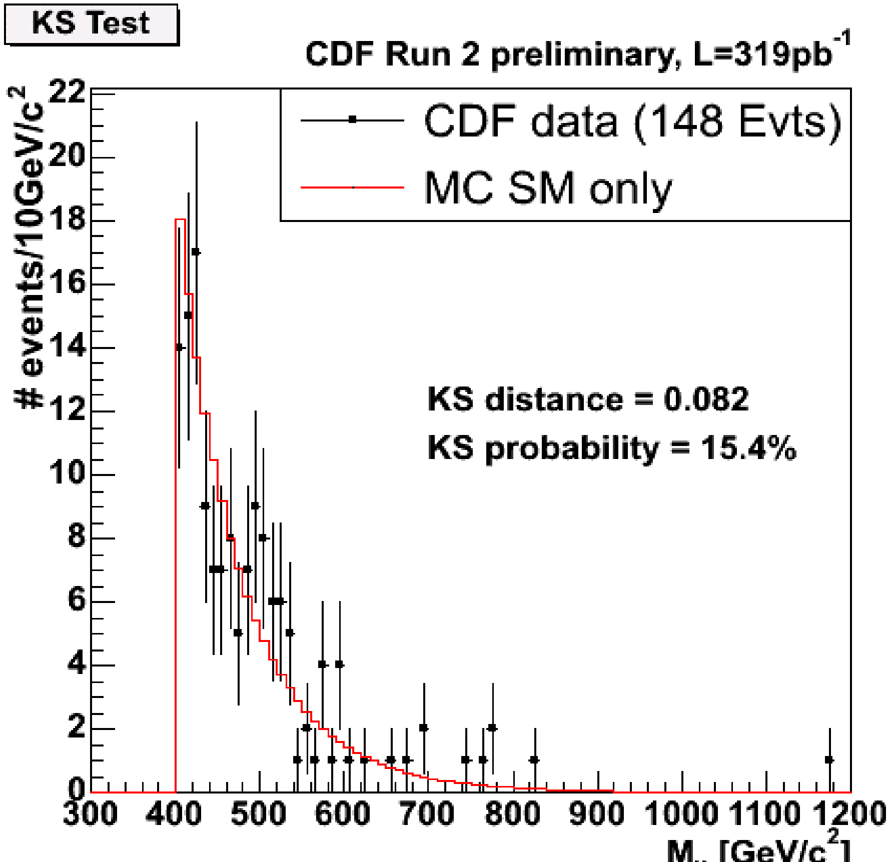
- Theoretical model : same Z' leptophobic topcolor, used in Run 1 and by D0. Width = 1.2% of resonance mass
- According to this model masses < 700 GeV are excluded.

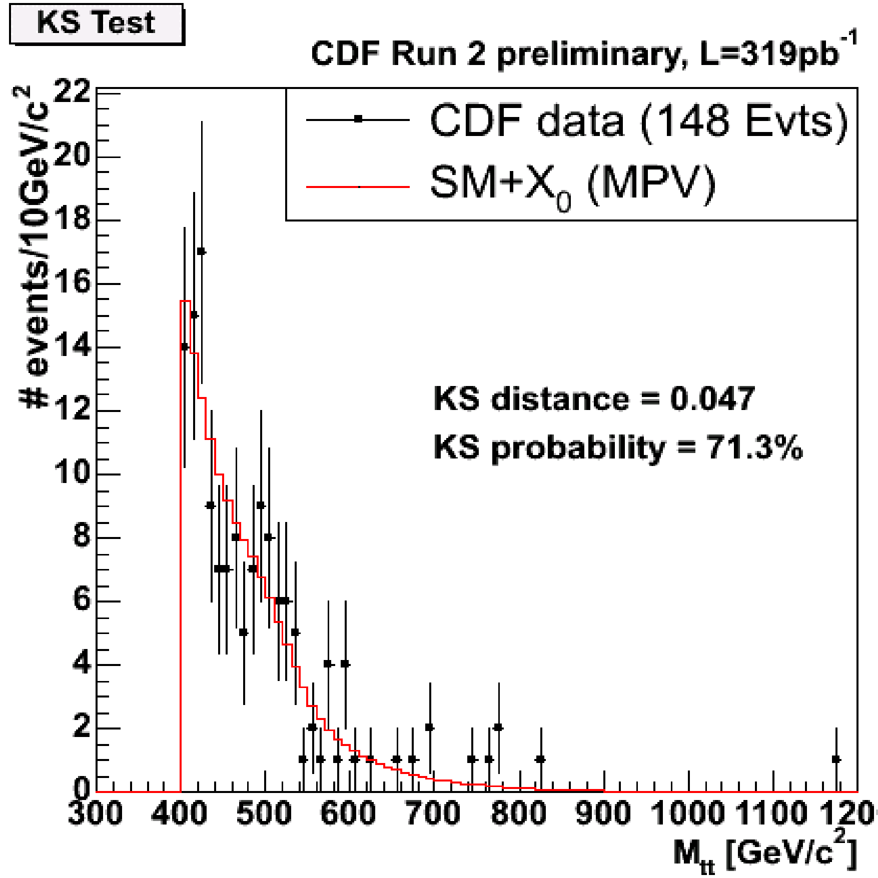
Mtt with MPV signal for 319 pb^{-1}



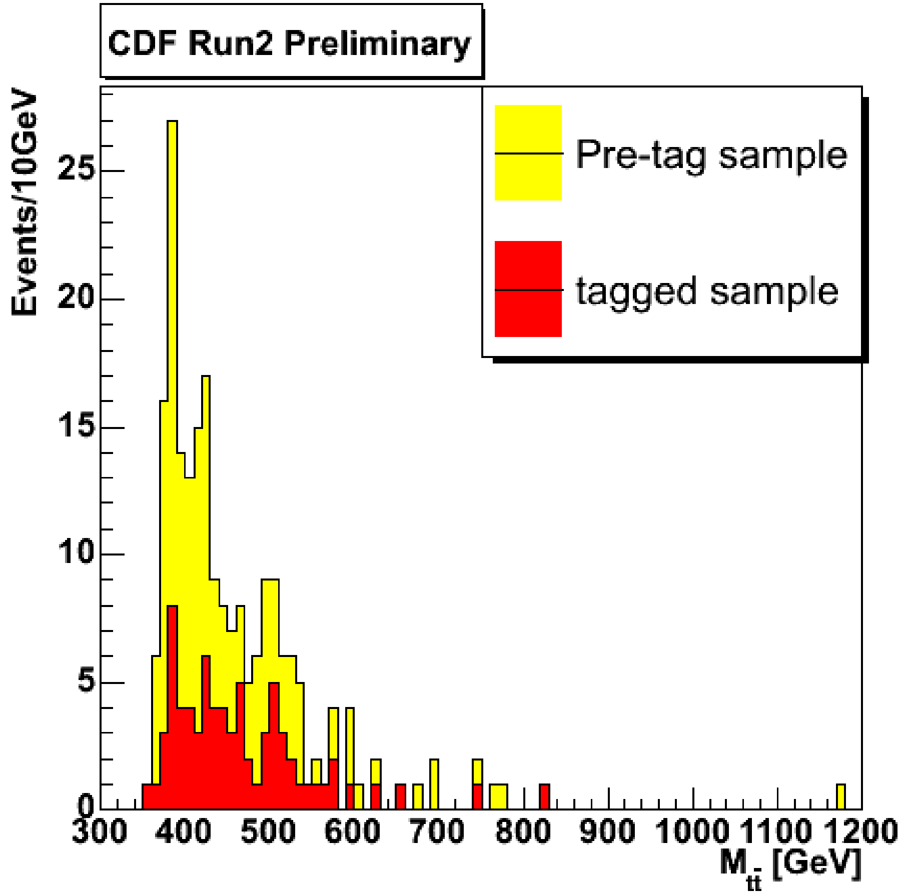
Kolmogorov Smirnov tests (319 pb^{-1})

- KS test w/o signal → prob=15.4%
- KS test w/ σ_{X0}=2 pb → prob=71.3% (MPV from posterior, M_{X0}=500GeV)
  - Testing only the shape, not the normalization
  - Events above 400GeV only





Where are the events with identified b-jets?

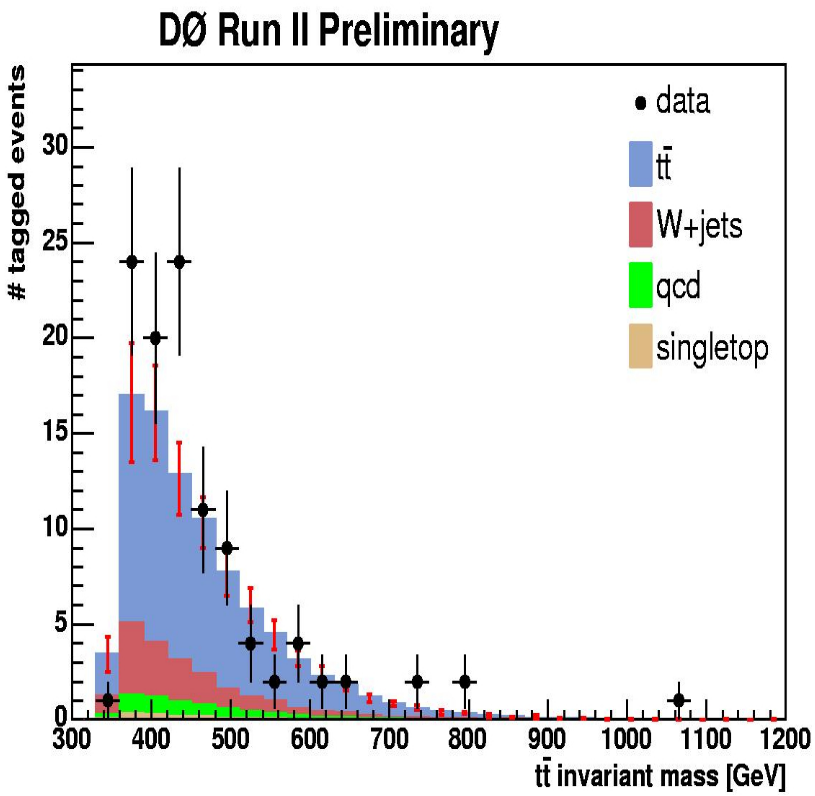


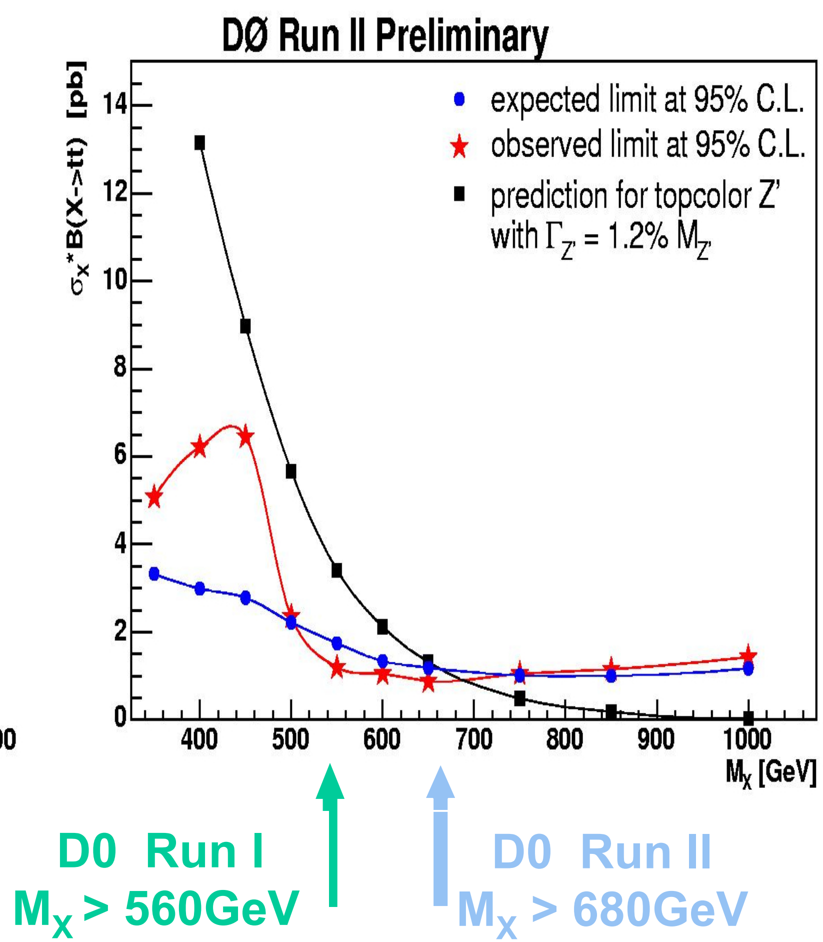
No statistical analysis has yet been done to this distribution
will do it in later versions of the analysis

D0 Run II Results (370 pb-1)

N = 108 events

Requires 1 or more b-tagged jets

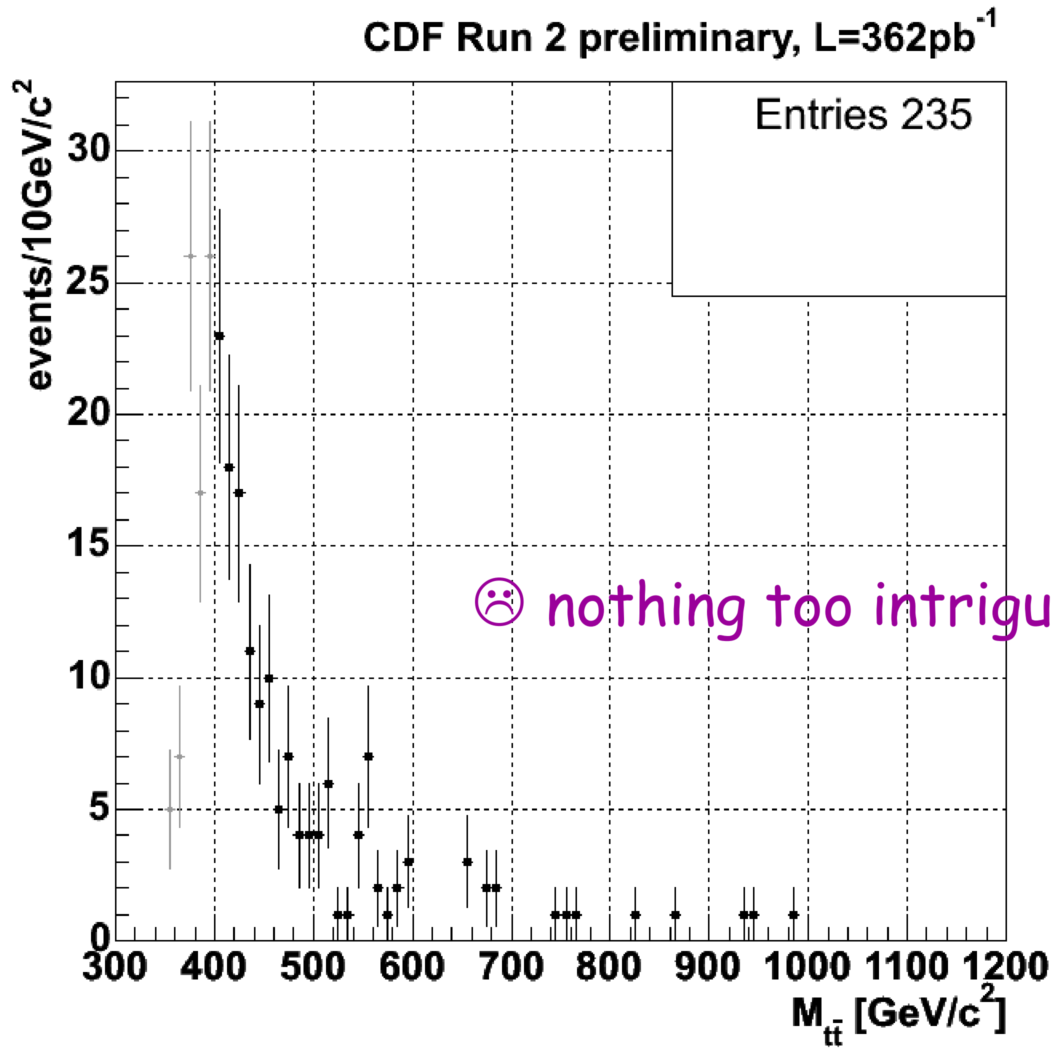




Summary after 319 pb^{-1}

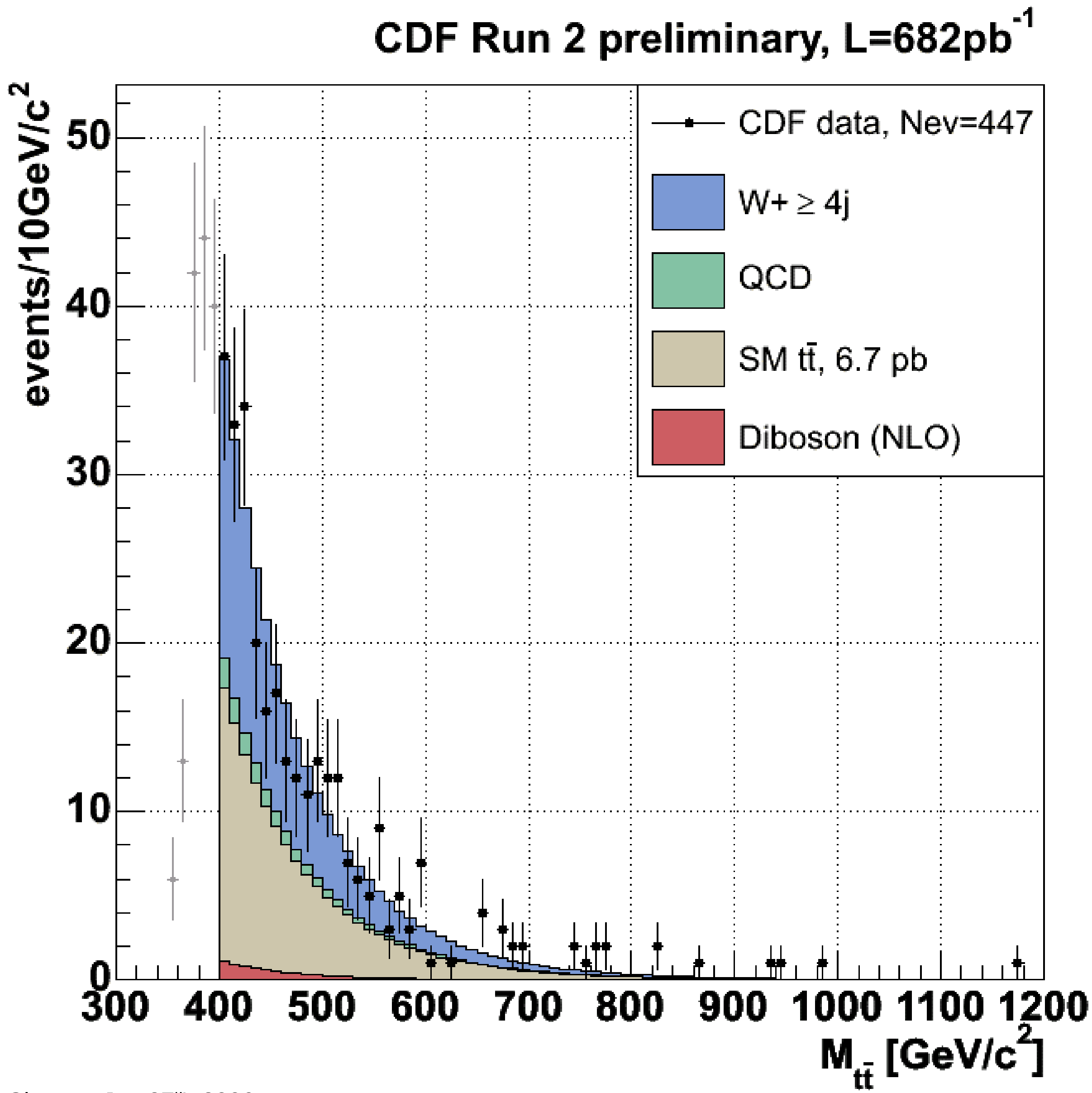
- Data still consistent with SM
- Intriguing peak around 500 GeV
  - 95% CL on resonance cross section is ~2-sigma from SM
  - KS is ~15% for SM only
  - KS test is ~70% with 2 pb Xo "contamination"
- We recently looked at more data (680 pb^{-1})
  - No changes made to the analysis
  - New data blind until validated
  - First time it is shown outside CDF

First: new data **only** (362 pb-1)

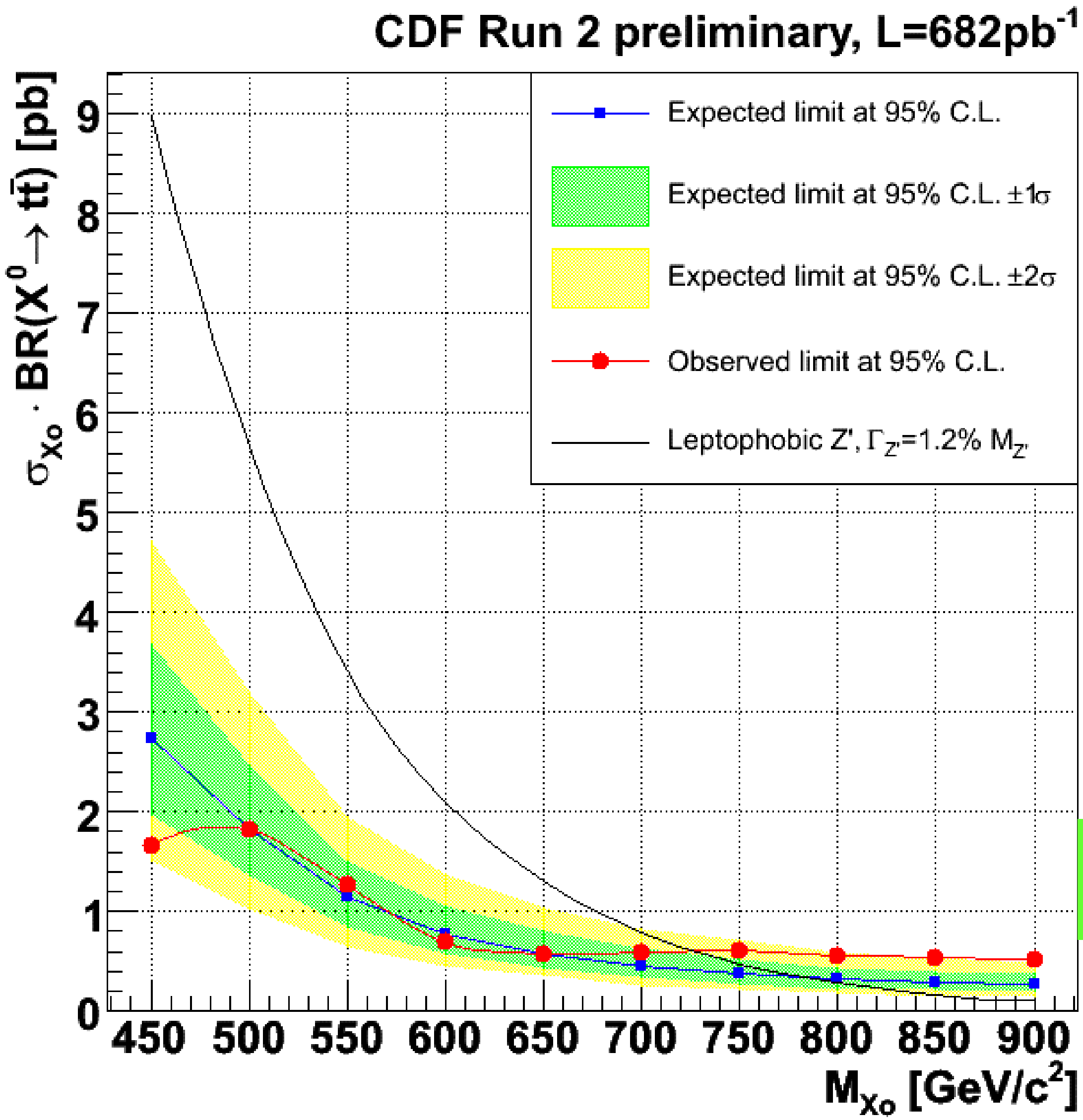


☹ nothing too intriguing at 500 GeV

Results with all data (682 pb^{-1})



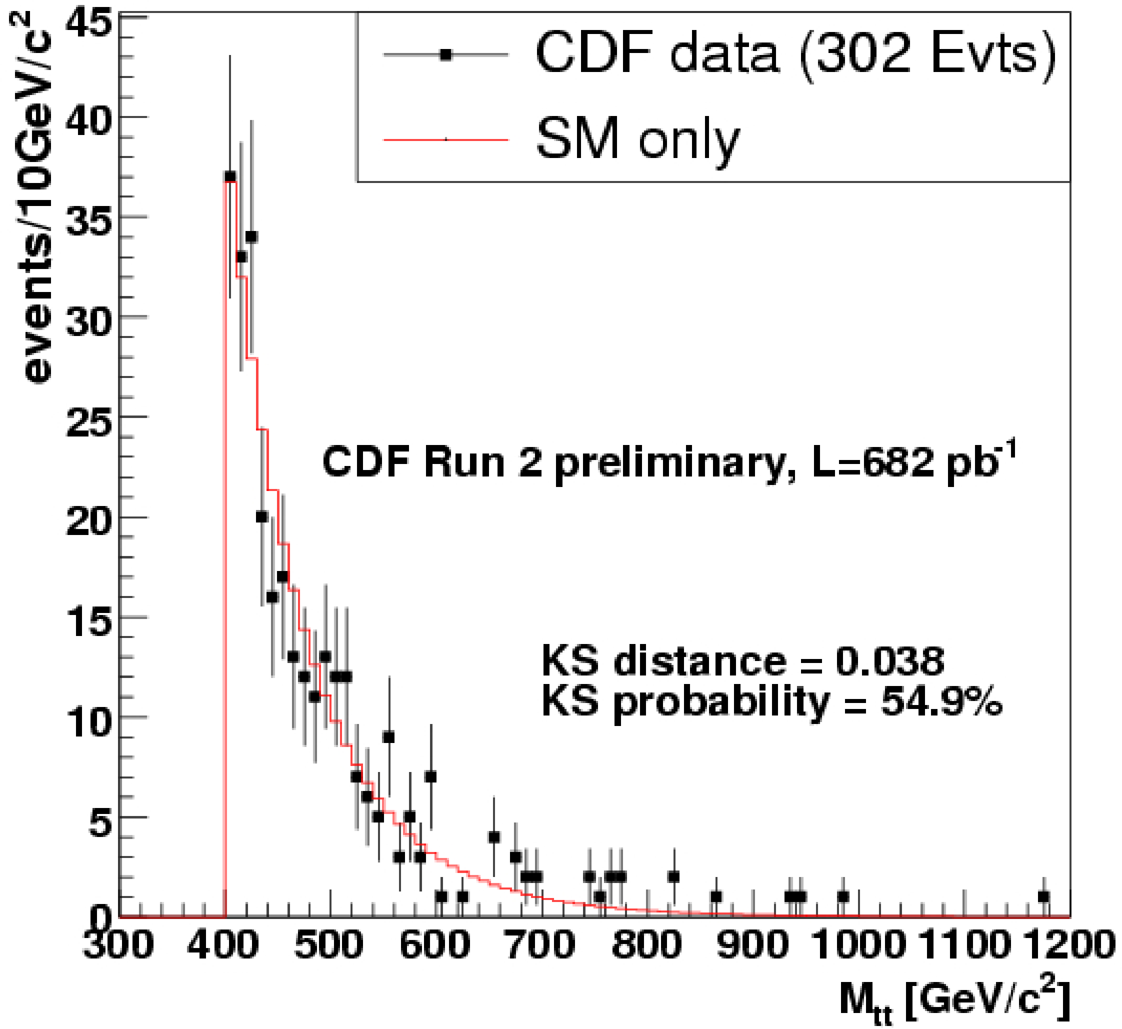
All data bump search results



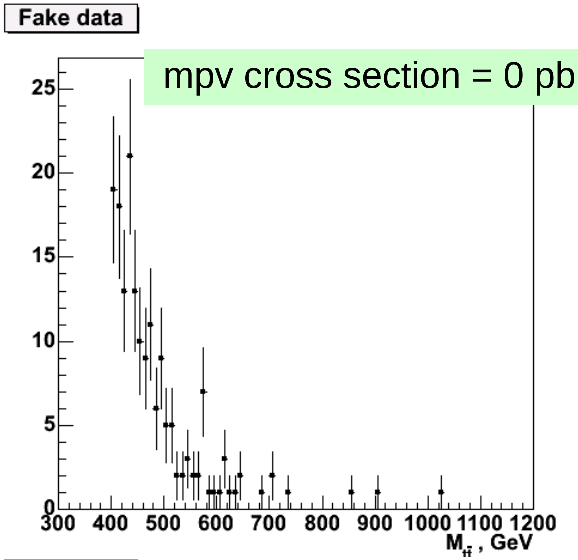
<725 GeV

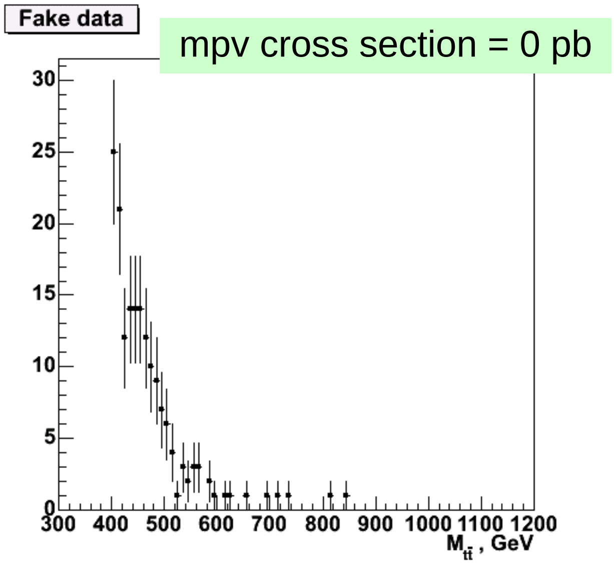
KS test for all data

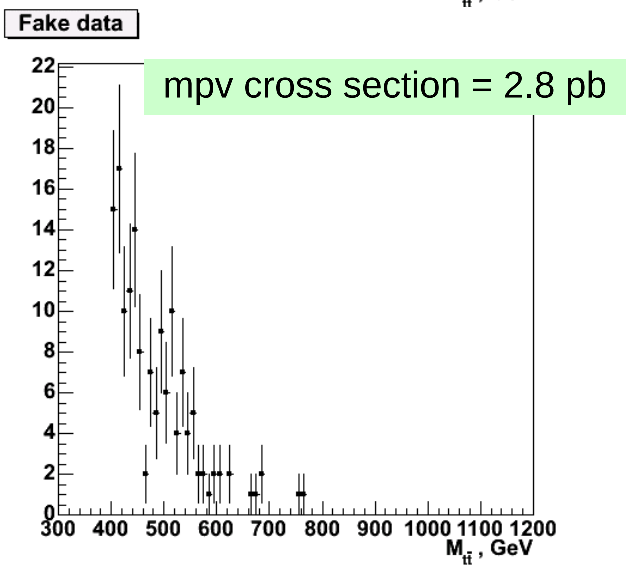
- KS test w/o signal → prob=55%
  Events above 400GeV only

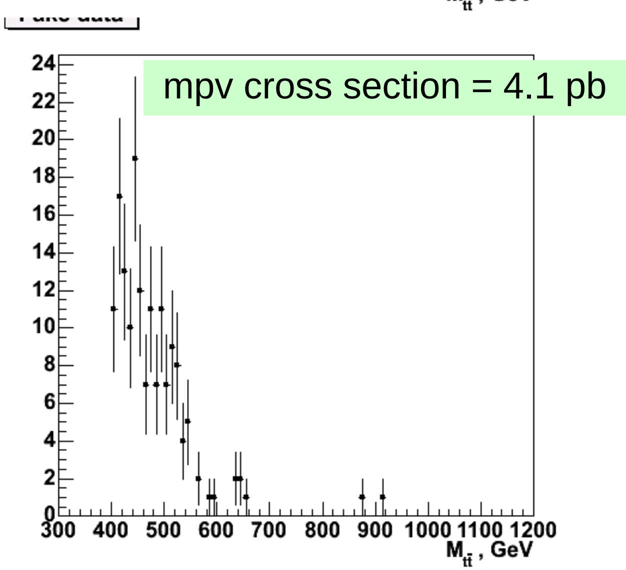


Fake 360 pb^{-1} experiments with ~7 pb SM tt and 2 pb X^o with M_{Xo}=500 GeV



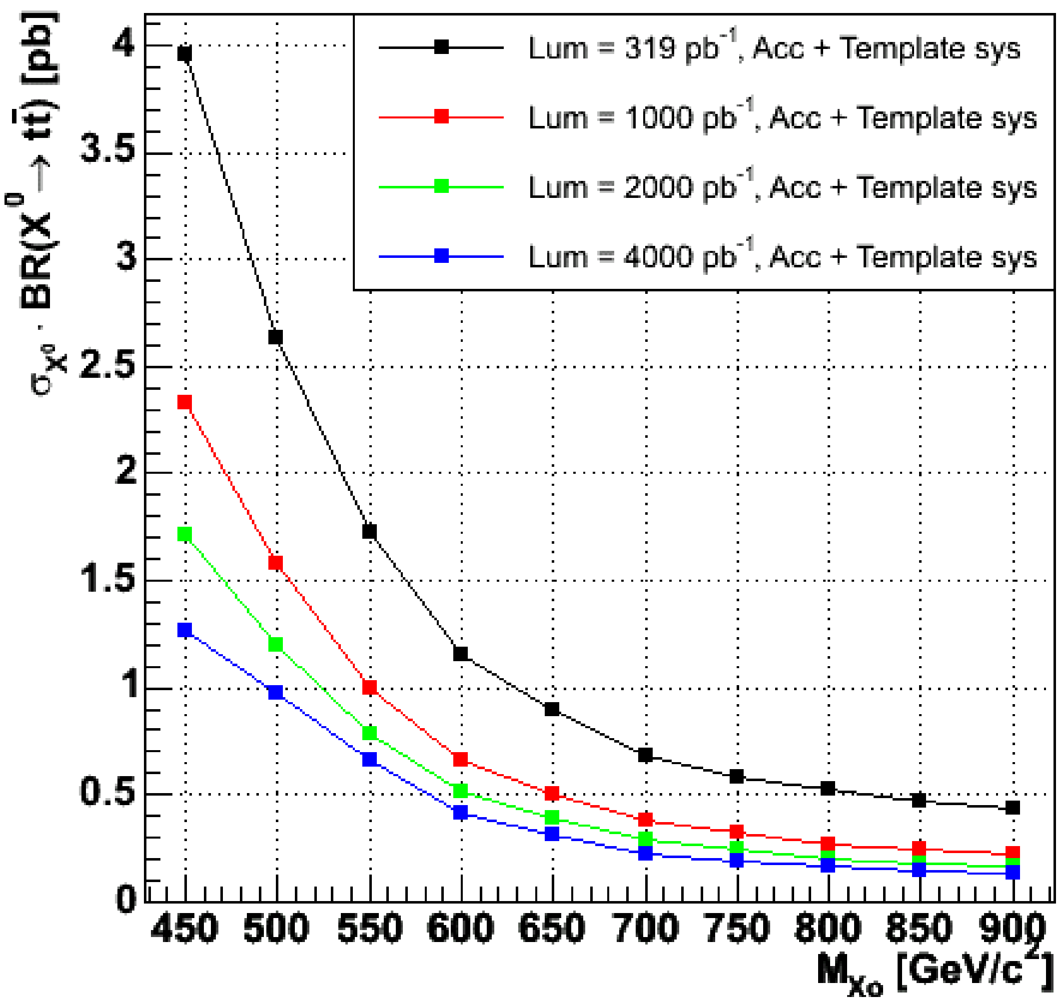






A small source of new physics can come and go in any given experiment

Sensitivity with more Luminosity



@1fb-1:

- M_{Xo}=500 → 25% σ_{tt}
- M_{Xo}=800 → 4% σ_{tt}

@4fb-1:

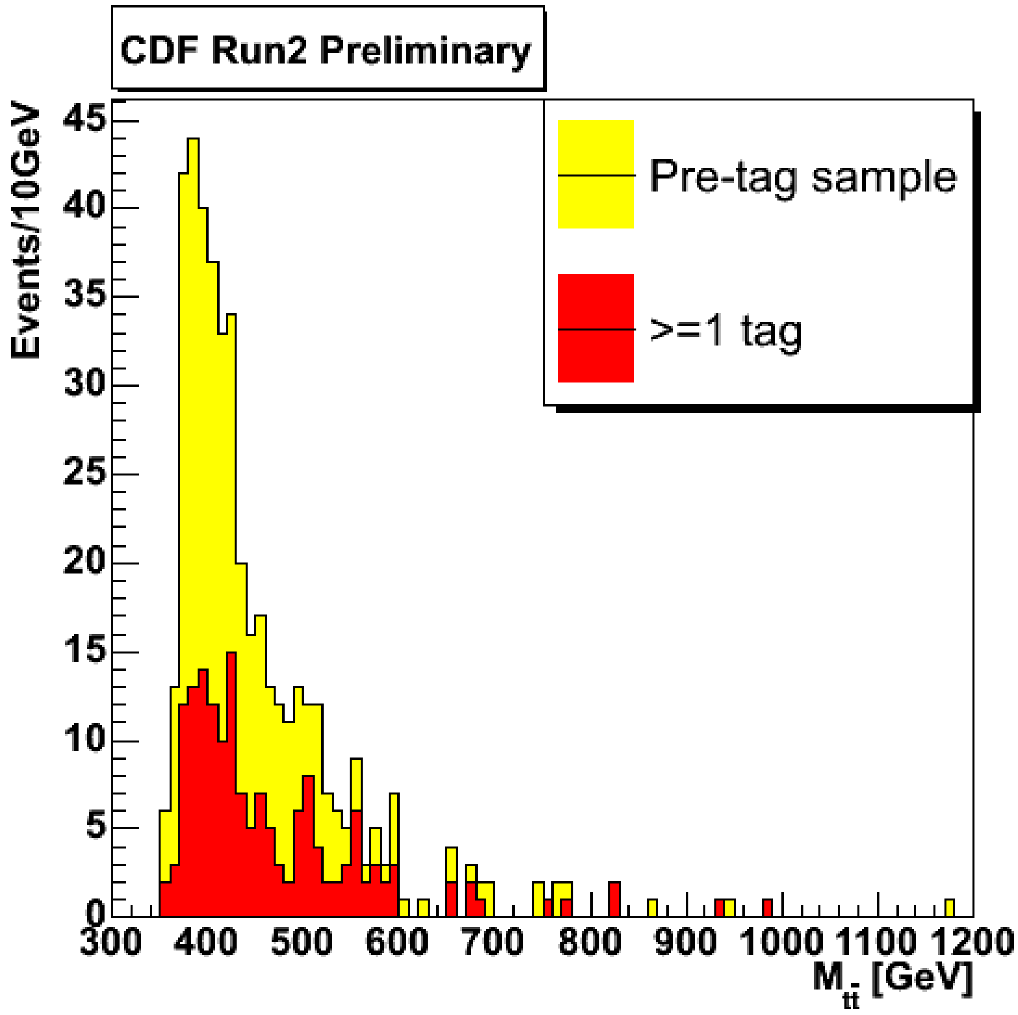
- M_{Xo}=500 → 15% σ_{tt}
- M_{Xo}=800 → 2% σ_{tt}

Summary and Conclusions

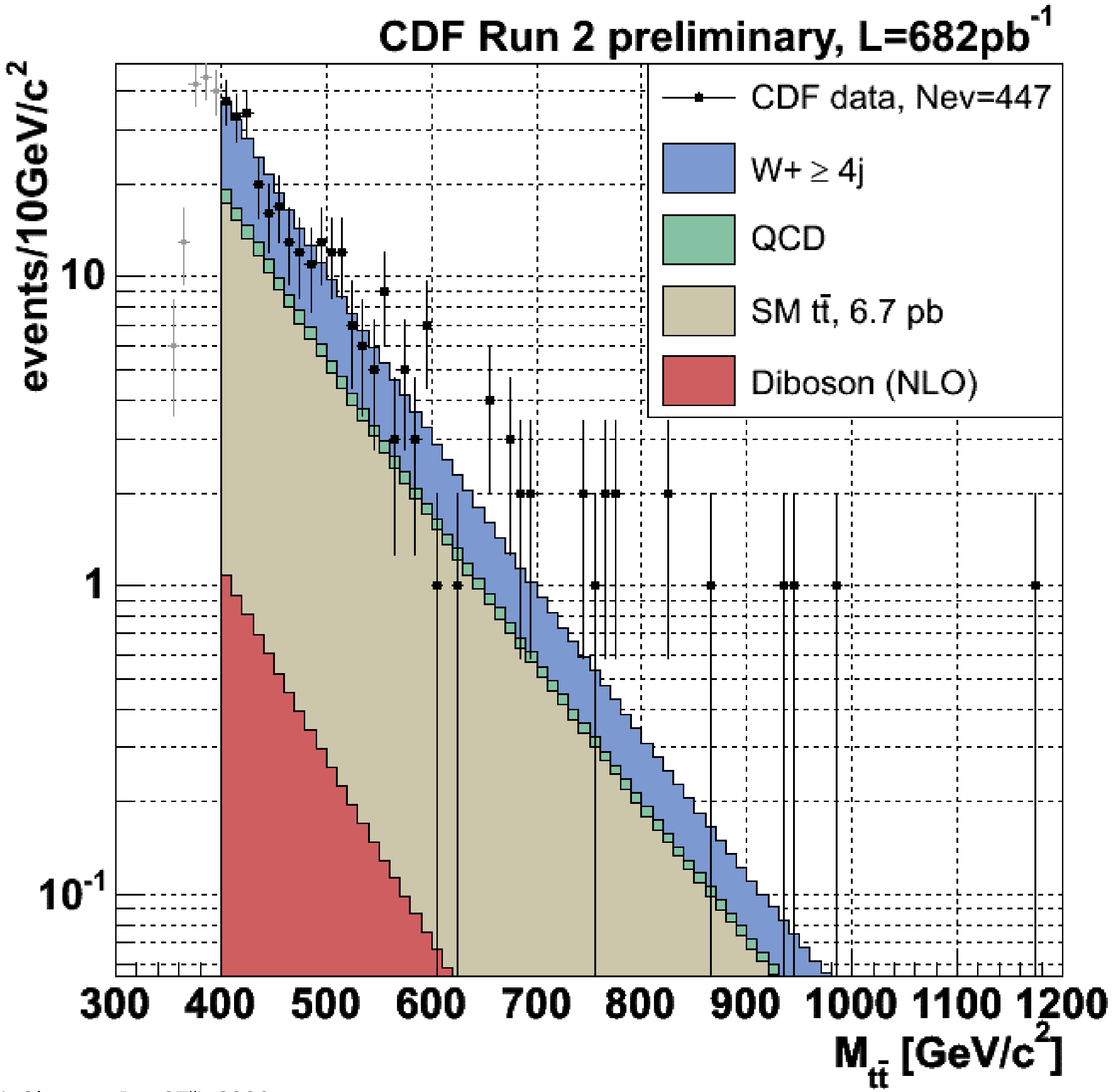
- By definition new physics will come in slowly
- We are very exicted that we can probe with a lot of data this important possibility for a discovery
- With ~6 fb^{-1} we will populate the Mtt distribution **x 10**
- **If anything is hiding there we will find it !**

BACKUP

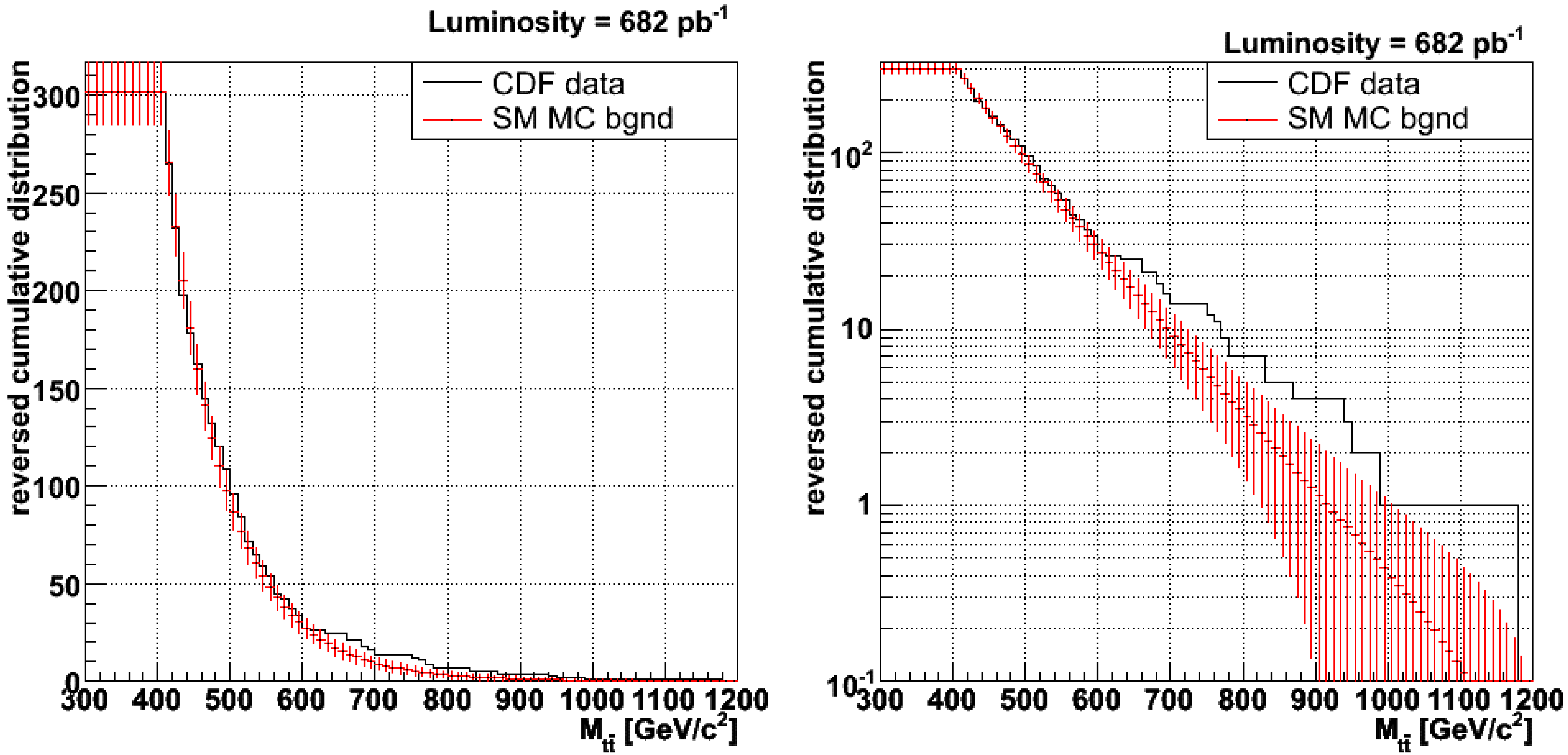
The tagged events (680 pb^{-1})



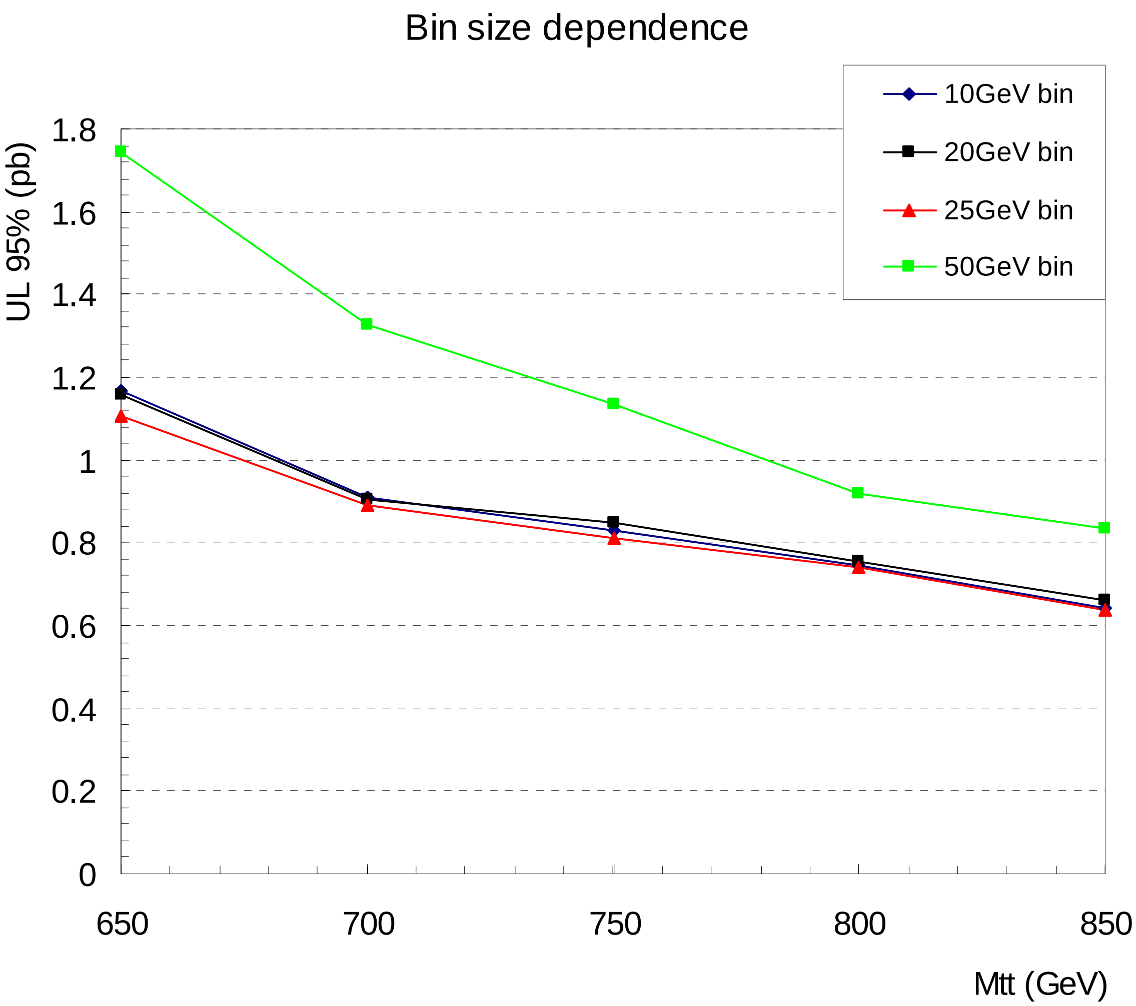
Results with all data (682 pb^{-1})



Integral Mtt distribution above 400 GeV



Sensitivity VS bin size



Search Methodology

Template weighting

- N_{Xo}: Based on assumed cross section and MC acceptances
- N_{tt} & N_{WW} : Based on theoretical Xsec and MC acceptances
- N_W & N_{QCD}: Balance from the data (N_{QCD}/N_W= 0.1)

$$N_{CDF}^{TOT} = \int L \cdot dt \cdot (\sigma_{Xo} A_{Xo} + \sigma_{t\bar{t}} A_{t\bar{t}} + \sigma_{WW} A_{WW}) + N_{QCD} + N_W$$

Likelihood & posterior

- N_W, N_{Xo}, N_{tt}, N_{WW}, N_{QCD} are used to combine the templates
- Build the total probability is:

$$L(\sigma_{Xo}, \vec{v} \,|\, \vec{n}) = \prod e^{-\mu_i} \frac{\mu_i^{n_i}}{n_i!}$$

- We integrate over nuisance parameters ν to take care of acceptance and cross section uncertainties and we get the posterior PDF using Bayes theorem

$$p(\sigma_{Xo} \,|\, \vec{n}) = \int d\vec{v} \times L(\sigma_{Xo}, \vec{v} \,|\, \vec{n}) \times \pi^{prior}(\sigma, \vec{v})$$

Inputs to the search – details

$$N_{CDF}^{TOT} = \int L \cdot dt \cdot (\sigma_{Xo} A_{Xo} + \sigma_{t\bar{t}} A_{t\bar{t}} + \sigma_{WW} A_{WW}) + N_{QCD} + N_{W}$$

- input σtt=6.7pb
  - uncertainty 12%
- input σWW=12.4pb (+20% to account for WZ, ZZ)
  - uncertainty 10%
- input N_{QCD} and N_W: balance to the data
  - $N_{QCD}/N_W = 0.1$

	N(@319pb-1)		Err
SMtt	65.9	45%	5.0%
WW	3.8	3%	0.3%
QCD	7.3	5%	--
We4p	36.9	25%	--
Wmu4p	34.1	23%	--

Tools validation on Top Mass

CompHep generator: flexible LO ME-based event generator, it allows to:

- Add interactions by editing the Lagrangean
- Select explicitly the diagrams to be used for event generation
- Compute the diagrams w/o approximations
- Interface with Pythia for parton shower

♥ Good companion for FlaME

- We generated 2 samples to validate the FlaME reconstruction code:
  - o $qq \rightarrow tt \rightarrow WbWb \rightarrow l\nu bqqb$
  - o $qq+gg \rightarrow tt \rightarrow WbWb \rightarrow l\nu bqqb$
- We reconstruct Mtop probability for:
  - o parton only, matched jets, correct and all combinations
  - o parton + gaussian smearing
  - o parton + TF smearing

Matrix Element for Top Mass

For each event the observables are **j** :

$$P(\mathbf{j} \mid M_{top}) = \frac{1}{\sigma(M_{top})} \sum_{\rho} \int dp_{\nu} \prod_{q}^{4} dp_{q} \iint dz_1 dz_2 \cdot PDF(z_1, z_2) \cdot d\sigma(\mathbf{p} \mid M_{top}, z_1, z_2) \cdot TF_{\rho}(\mathbf{j} \mid \mathbf{p})$$

$$d\sigma(\vec{p}_i | p_k, p_l) = \frac{|\mathcal{M}|^2}{4E_k E_l |v_k - v_l|} \cdot (2\pi)^4 \delta^4(p_k + p_l - \sum_{i=1}^{6} p_i) \cdot \prod_{i=1}^{6} \frac{d^3\vec{p}_i}{(2\pi)^3 \cdot 2E_i}$$

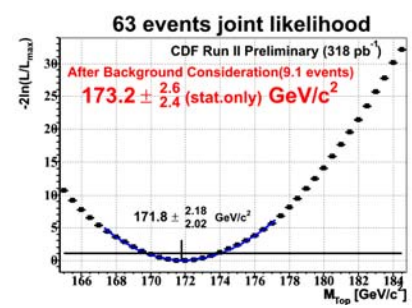
- The formula provides the relative probability of an event (as a whole) to be produced from a pp->tt process as a function of the top mass.
  - Output is not a single value but a probability function.
  - Formula accounts also for the jet-parton combinations (ρ).

To combine the measurements from n events in a sample:

- Multiply the probabilities

$$L(M_{top}) = P_1 P_2 \cdots P_n$$

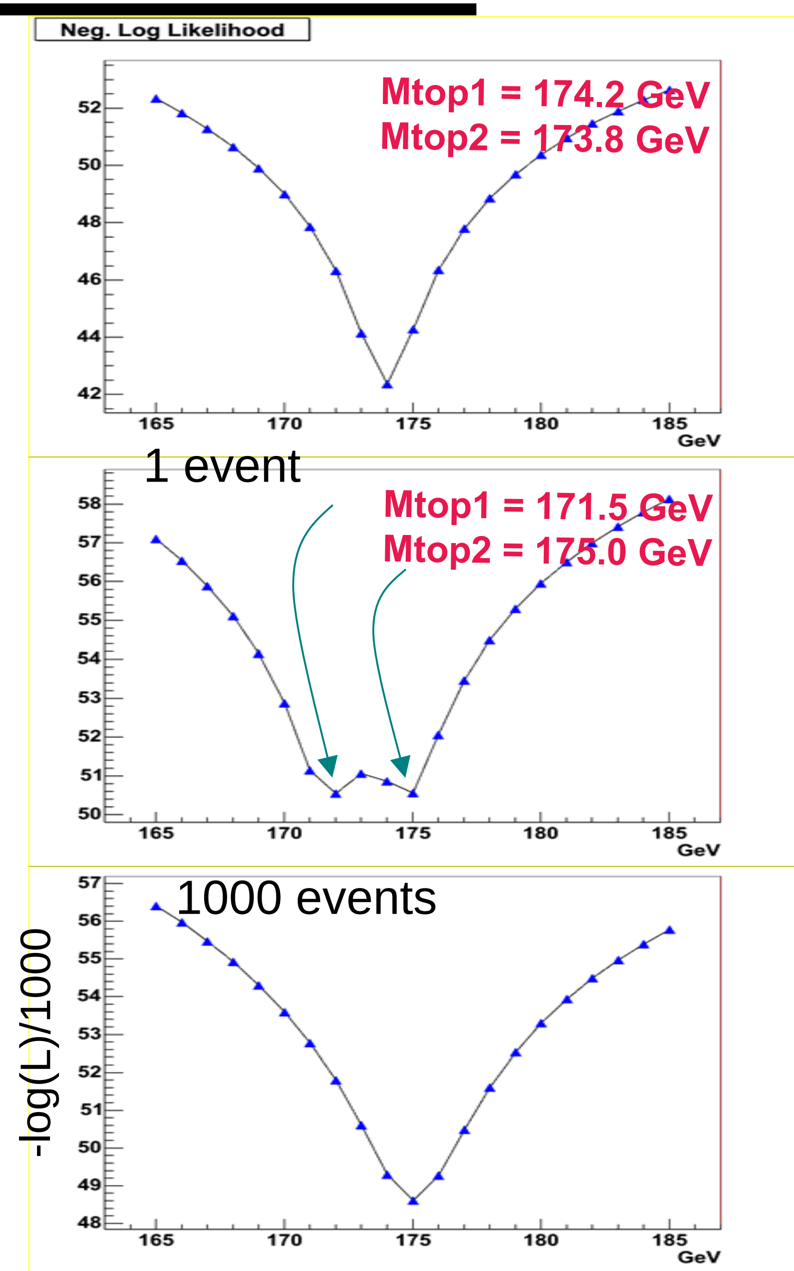
- Most probable value is the reconstructed top mass.



- This method is based on an original idea proposed in 1988 by Kunitaka Kondo. (J.Phys. Soc. 57, 4126)
- Method has been used to measure top mass at CDF and D0.
  - Mtop = ...CDF paper
  - Mtop = ... D0 paper

parton level checks

- Single event likelihood shapes.
  - correct combination
  - no detector effects
- L tracks nicely each top mass on each event!



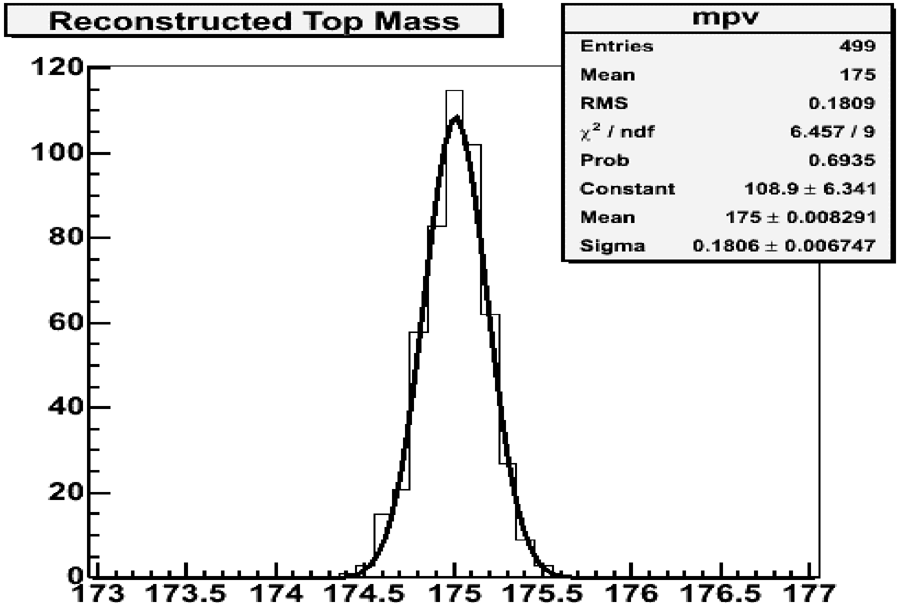
1000 events likelihood:

Returns exactly the input mass

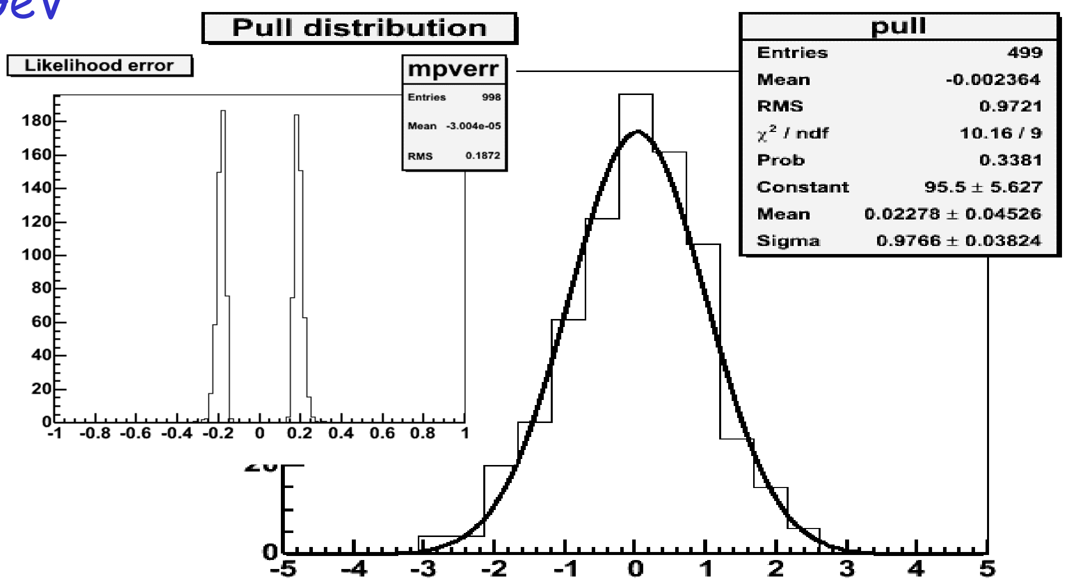
parton level pseudo experiments

Build 250 pseudo experiments of 20 events each:

- Consider all 24 permutations
  - o M_{top} = 175.00 ± 0.01 GeV



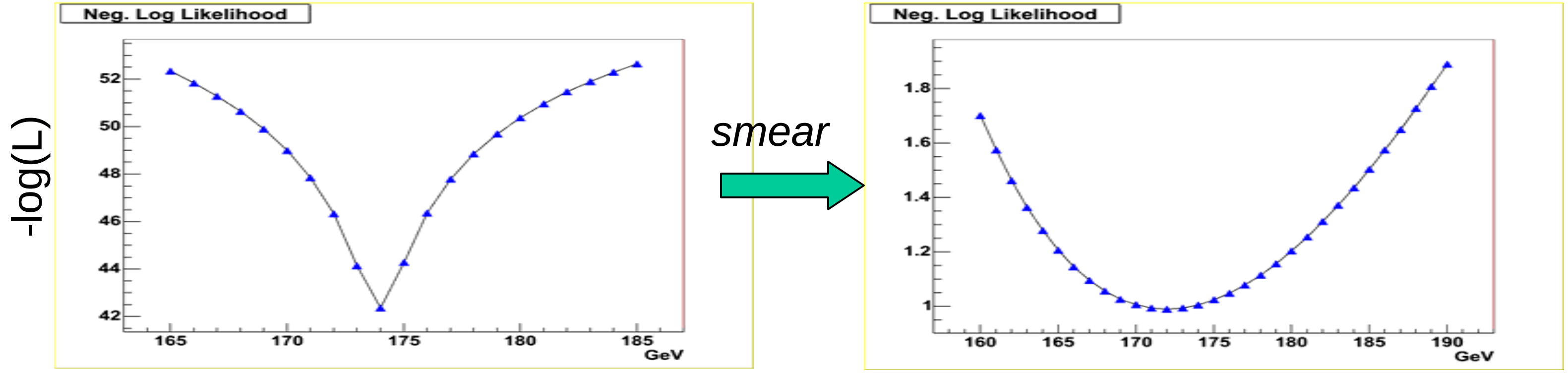
- Calculate pulls from:
  - o RMS = expected ΔM = 0.18 GeV
  - o $|\Delta \log L|=1/2$
- Pulls' Sigma = 0.98 ± 0.03



parton level with gaussian smearing

We apply 20% gaussian smearing to parton energies

For same single event shown before:



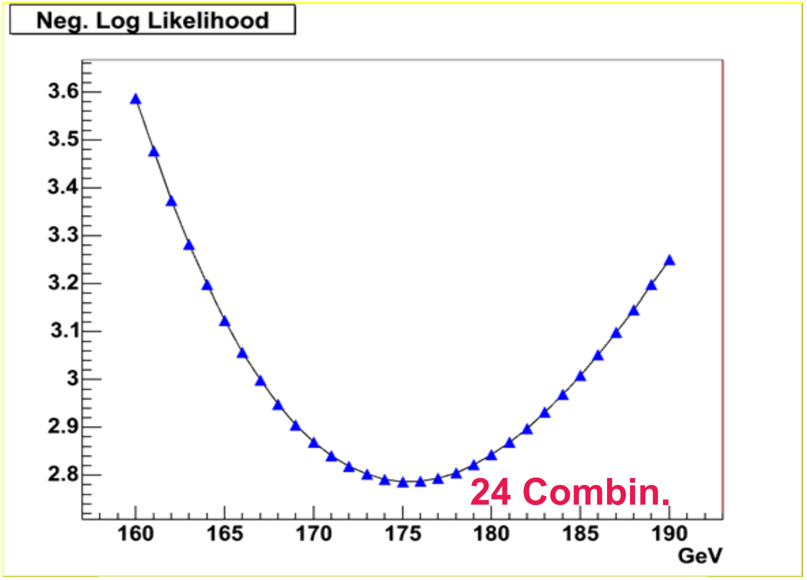
High statistics test.

Reconstructed top mass on 5k events

- Mtop=175 GeV

With high-stat smearing

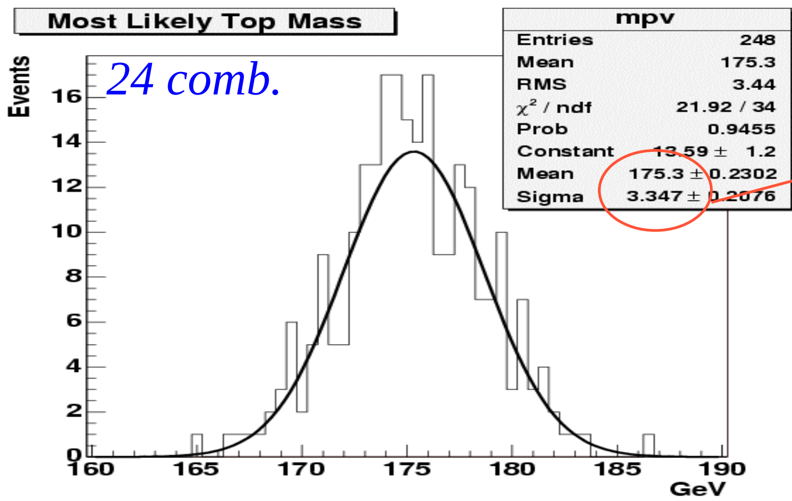
no bias added



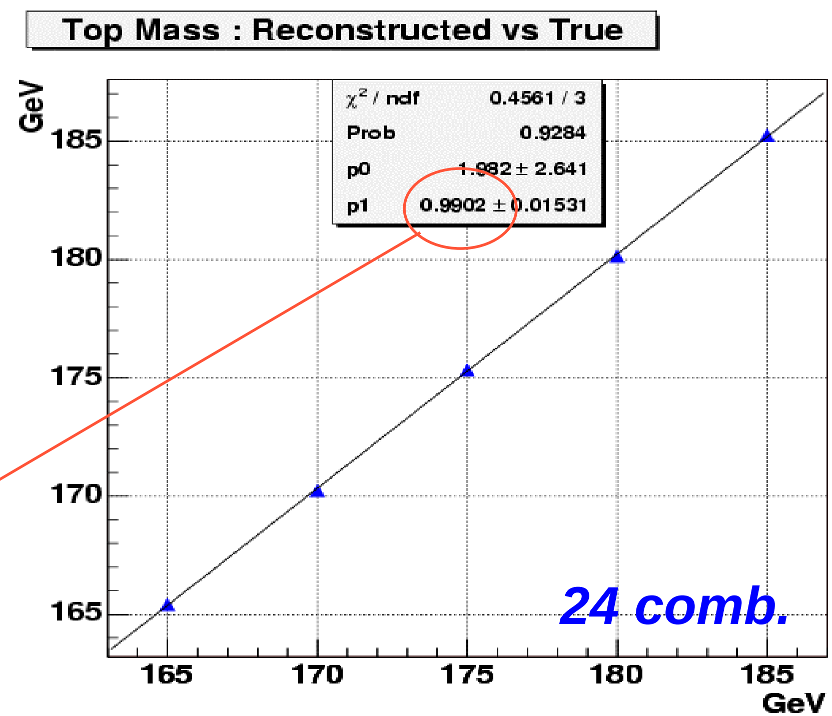
Mtop = 175.4 ± 0.2 GeV

parton level with gaussian smearing

- PEs of 20 events



For 20 evts a small ~3 GeV uncertainty expected for 20% smearing !

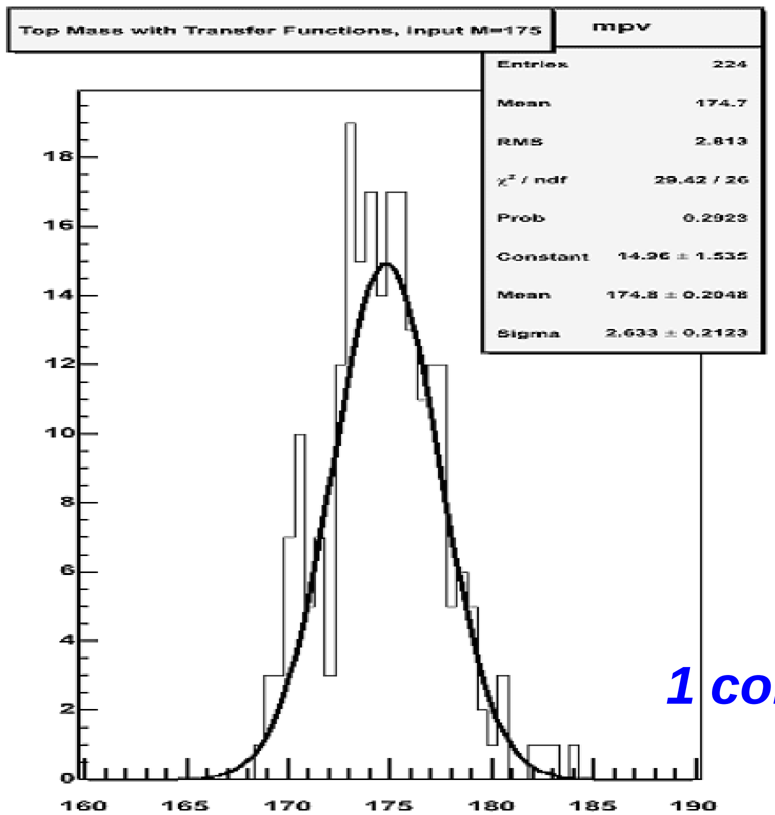


- Run set of pseudoexperiments with different input Mtop to check linearity of the reconstruction algorithm

- Perfect linearity

parton level with transfer functions

- For TF VALIDATION purposes we ran a special test :
  - Only events with jets matched to partons
  - Only the correct combination
  - Jet direction replaced with parton direction
- Pes of 20 ev :



Mean = 174.8 ± 0.2
Sigma = 2.63 ± 0.21

1 comb.

Mtop summary

- Method has been tested piece-by-piece
  - matrix element
  - transfer functions
- Top mass reconstructed w/o any bias

Expected sensitivity for optimists

Power : 1 fb^{-1}

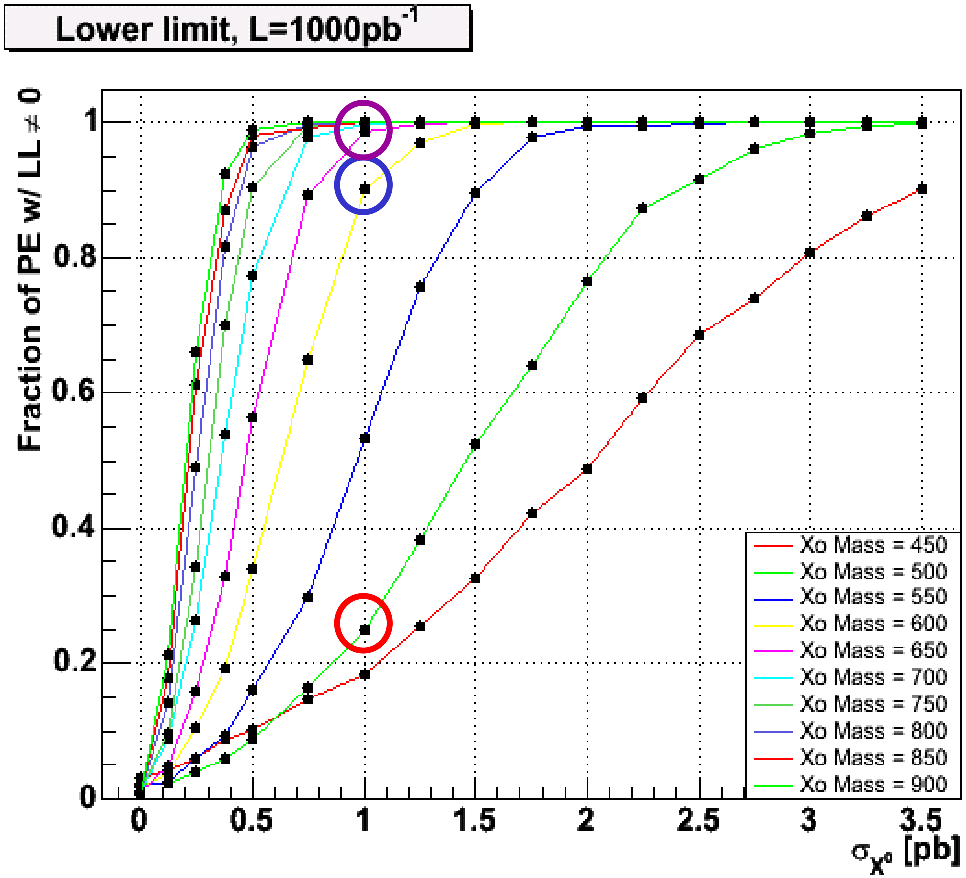
power of the algorithm

in discriminating

Sig from Bkg as

fraction of PEs with

LL(@95%CL)≠0



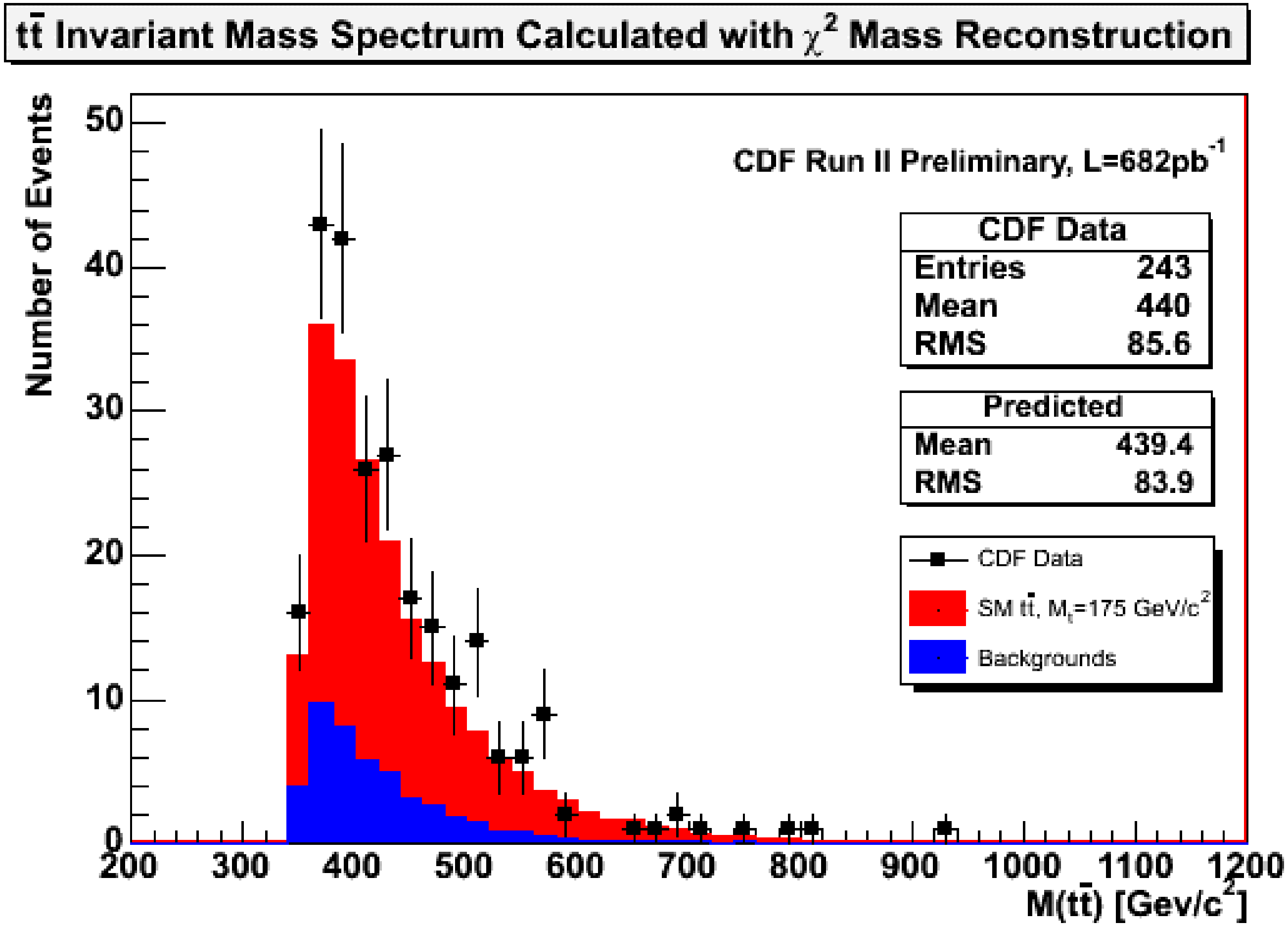
If 1pb signal is present:

For M_{X0}=500GeV, at L=1fb^{-1}, LL(@95%CL)≠0 on 25% of the experiments

For M_{X0}=600GeV, at L=1fb^{-1}, LL(@95%CL)≠0 on 90% of the experiments

For M_{X0}=700GeV, at L=1fb^{-1}, LL(@95%CL)≠0 on ~100% of the experiments

Mtt spectrum from χ^2 reconstruction



Mtt mass spectrum reconstructed via χ^2 minimization.

Many thanks to Michael Kagan.